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1. MANAGEMENT

Gas Industry Management

Humble Sidesteps FPC Control in Biggest Gas Sale Ever. *Oil Gas J. 59,* 72 (1961) Apr. 24 (2 pp.); **Humble Makes Largest In-Place Sale.** *Petrol. Week 12,* 18 (1961) Apr. 21 (2 pp.)

Planned in-place gas sale would switch ownership of 6.2 trillion CF from Humble to Monterey to Columbia Gas. Key to deal involving nearly a billion dollars worth of gas reserves is a third company (Monterey). New company would also purchase Humble's King Ranch-to-Houston 30-inch gasline.

Gas Industry Expansion

Gas in the Domestic Market. G. M. Polanyi. *Gas World 153,* 498 (1961) Apr. 8 (10 pp.); *Gas J. 306,* 83 (1961) Apr. 19 (5 pp.)

Author, a statistican, believes that the strategy for gas in the domestic market would seem to be twofold: maintain the existing loads and push forward into central heating. The most crucial issue, he believes, is not whether coal or oil is to be used in gasification processes, but whether the industry (in Great Britain) is to be allowed to import natural gas. Such a measure is essential to the British gas industry not only to strengthen its future in the domestic and other markets, but also as a means of strengthening its competitive position, in particular against European rivals.

Air Conditioning

Manufacturer Market Policies. *Gas Heat and Comfort Cooling 12,* 38 (1961) Apr. (5 pp.)

During 1961, residential central air conditioning will become an established market—or it will remain a "toy," something that the public does not really want. Which way it goes will depend equally on individual dealer merchandising at the local level and on manufacturer marketing policies at the national level. Sixteen corporate chief executives—or their spokesmen—present their views. Keynote of all policies: they are all dependent on dealer organization and follow-through.

Customer Service

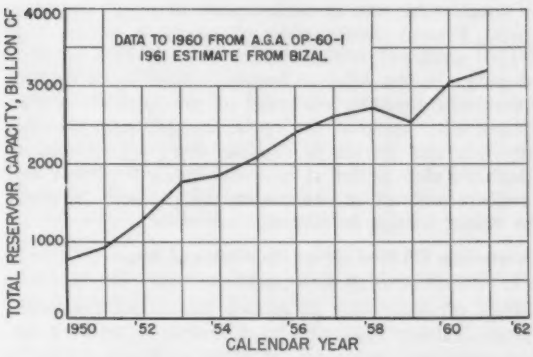
Michigan Consolidated Gas Company Detroit District Service Shop Quality Control Program. J. L. Joachim and G. W. Lizenby. Paper No. DMC-61-23. (New York: American Gas Association, May 1961; $0.25)

Authors describe their company's eight-point quality control program in customer service, which is built around a good system of inspection. Techniques are outlined.

The Value of Machine Accounting to Customer Service Operations and Management. J. H. Dennis. Paper No. DMC-61-17. (New York: American Gas Association, May 1961; $0.25)

Author describes customer growth and the need to update assimilation of statistical data in order to better serve both new and old customers. His company, the Long Island Lighting Company (New York), after considerable study, replaced old gas service order cards with a two-part IBM-type of card, and adapted the mark sense system. In his paper, author describes how an order is processed via this system, and into what other areas the system may be extended.

Underground Gas Storage in the United States



(*Gas Storage Capacity Climbs . . . .* See abstract, p. 99)

Federal Power Commission

What's Ahead for Natural Gas Field Price Regulation? R. E. Field. *Am. Gas J. 188,* 9 (1961) May (2 pp.)

Future course of natural gas field price regulation by the Federal Power Commission remains uncertain despite the area price approach announced a few months ago by the Commission as an effort to break through the complexities of rate making. Working rules for area pricing have never been established, and already its existence is threatened by the change in federal administration. Author discusses some of the problems and offers some suggested solutions.

Foreign Activities

India Foresees Upsurge in Oil Demand. R. G. Gibson. *Oil Gas J. 59,* 87 (1961) Apr. 17 (2 pp.); **India Pitches into Big New Oil Hunt.** *Ibid.,* 85 (1961) Apr. 24 (2 pp.); **Oil, Gas Will Help Lick India's Food Plight.** *Ibid.,* 81 (1961) May 1.

Author has written this series because he believes that in a matter of decades, India will become one of the world's most important oil markets. On the basis of available data, he predicts that consumption should double to 280,000 bbl/day in five years. Apparent success of recent operations is spurring the government into earmarking $44 million for exploration, despite financial strain and lack of trained personnel. Bent on stepping up its agricultural resources, India looks to oil and gas industries to supply feedstocks for nitrogen-fertilizer projects. In the next five years, $500 million will be spent on expanding fertilizer capacity.

India's Drive for Oil Self-Sufficiency. W. B. Metre. *Petrol. 24,* 133 (1961) Apr. (4 pp.)

India's plans for rapid industrialization are leading to a considerable rise in consumption of petroleum products. Present consumption of nearly 8 million tons (1961 estimate) is expected to double within the next decade. In her drive to become self-sufficient in both petroleum products and crude oil supply, India sets an example to some of the newer independent countries of Asia and Africa in inviting foreign participation. Author's view is that a favorable taxation climate and a liberalized set of concession rules would do much to attract foreign investment.

Australian Oil Find Whips Up Waves of Hope. *Oil Gas J. 59,* 78 (1961) May 8 (2 pp.)

Many of Australia's 28 known basins still are unexplored. Union Oil's new hit, Cabawin 1, the most encouraging well since the discovery at Rough Range in 1953, has rekindled Australian oil fever. This, coupled with the fact that other promising regions exist, points to ambitious efforts to find commercial production. The country now has the biggest concentration of geologic know-how and drilling ability ever assembled during its long search for oil.

Oil in Africa. Part 1. Petroleum Geology of Libya. C. A. Fothergill. *Petrol. 24,* 137 (1961) Apr. (5 pp.)

Africa has become a major center in the development of the world's oil resources, particularly in the North of the continent. The first area discussed by the author, and one on which geological information has only just become available, is one of the most recently discovered and likely to prove the most prolific: Libya. Before doing so, however, the background to oil discovery in Africa is outlined.

Petrochemicals

Petrochemicals in West Germany. S. R. Krueger. *Chem. Eng. Progress 57,* 79 (1961) Apr. (6 pp.)

West Germany today occupies fourth place in world chemical production behind the United States, the Soviet Union and Great Britain. Author surveys petrochemical and coal chemical industries. He includes a discussion of raw materials and of petrochemical enterprises and their main products.

Research

A.G.A. Research in Domestic Cooking Equipment. F. G. Hammaker. Paper No. DMC-61-6. (New York: American Gas Association, May 1961; $0.25)

Author describes the activities carried out by the A.G.A. Laboratories in Cleveland in the field of cooking research. Since the first bulletin was published in 1932, these activities have grown until today research projects, both current or just completed, span almost the entire domestic gas cooking field. Some of the more important research activities are described.

Pipeline Research Reaches Milestone. F. H. Love. *Pipeline Eng. 33,* D-36 (1961) May (2 pp.)

Eight years of work on pipe performance conducted by the A.G.A. and Battelle Memorial Institute (Columbus, Ohio) were comprehensively discussed at a recent seminar. Objective of research: learn more about performance characteristics of line pipe in order to develop safe and practical pipeline design procedures. As a result of the work, two areas are seen for the revision of Code B31.

Hazards in the Field for the Serviceman. F. P. Mueller. Paper No. DMC-61-11. (New York: American Gas Association, May 1961; $0.25)

Along with the greatly increased demands for natural gas in the home and industry have come new and different problems—problems of service and distribution. As a result, the gas serviceman finds himself confronted today with numerous and varied hazards, many of which are quite unrelated to the gas utility business. They arise out of driving a motor truck, working in blighted areas, entering dark basements, encountering vicious dogs, and being confronted with the unpredictability of people. These are discussed.

Safety

Principles of Explosion Prevention. J. H. Burgoyne. *Chem. & Process Eng. 42,* 157 (1961) Apr. (5 pp.)

In the chemical industry, explosions most commonly arise from uncontrolled reactions or decompositions in the liquid or solid state, and from rapid combustion or decomposition reaction of gases or aerosols. Article is concerned with latter type of explosion, particularly with regard to explosions of gases and vapors in air.

Some Claim Factors in Gas Operations. J. C. Bruckmann. Paper No. DMC-61-7. (New York: American Gas Association, May 1961; $0.25)

It appears that the increase in claims against gas companies has been accompanied by an increase in jury awards, in some cases to seemingly astronomical amounts. As the author sees it, there is an unfolding of new theories of liability and an enlargement of beliefs of how much money is adequate for an injured person. While there are three sides to this picture, author is primarily concerned with only one side: that of studying all phases of gas company operations in the light of these new conditions.

Stop Disaster!—Major Goal of Newest API Committee. J. C. Ducommun. *World Petrol. 32,* 48 (1961) Apr. (2 pp.)

New organization dedicated to the prevention of refinery processing accidents has become a regular part of the Division of Refining of the American Petroleum Institute. Called the Operating Practices Committee, it came into being in January, 1960, after nearly two years of planning and development. While it will give its main attention to efforts to prevent major accidents, the new committee also will study means of preventing upsets of a less serious nature, and the general improvement of refinery operations.

Revitalize Your Safety Program. A. Lateiner. *Petrol. Refiner 40,* 259 (1961) May (4 pp.)

Written for supervisors, article presents easily organized plan that takes only five hours, and which can add renewed life to safety efforts. Objective of program: to change attitudes toward safety measures. Course achieves purpose by aiming at lowest, as well as highest, supervisory levels. It is at the lowest level, says author, that most effective action regarding accident prevention can be instituted.

Synthetic Lubricants for Air Compressors. C. Kiner. Paper No. CEP-61-9. (New York: American Gas Association, May 1961; $0.25)

Author's objective is to relate the experiences that the Ohio Fuel Gas Company gained through the use of synthetic lubricants in their starting air compressors. Since changing to synthetic lubricants, the company has not experienced a single instance of fire or explosion in the starting air lines. The advantages gained through greater safety and reliability against fire or explosions in the compressed air systems far outweigh any disadvantages or inconveniences experienced by using a synthetic lubricant.

The Industry Speaks on Safely Operating that Low Temperature Plant. Impurity Control in Air Separation Plants. F. G. Kerry and J. T. Hugill. *Chem. Eng. Progress 57,* 37 (1961) Apr. (5 pp.); **Hydrocarbon Control in Air Separators.** E. Karwat. *Ibid.,* 41 (5 pp.); **Oxygen Plant Vaporizer Explosion.** G. T. Wright. *Ibid.,* 45 (4 pp.); **Oxygen Plant Explosion.** L. G. Matthews. *Ibid.,* 48 (2 pp.); **Heat Exchanger Explosion at a Nitrogen-Wash Unit.** S. F. Bohlken and N. V. Mekog. *Ibid.,* 49 (4 pp.); **Nitrogen Wash Incident.** J. H. Conklin. *Ibid.,* 52 (3 pp.); **Automatic Hydrocarbon Analyzer.** L. W. Coleman. *Ibid.,* 55 (4 pp.); **Operating Practices.** *Ibid.,* 59 (3 pp.)

Articles discuss in successive order: the control of hazardous hydrocarbon levels by use of adsorption filters and catalytic oxidation units; effectiveness of adsorption at the cold end of regenerators; analysis of the causes that led to plant changes for improving safety; hydrocarbon concentrations in the main condensers as cause of detonation; importance of stringent safety requirements when considering hazards of the oxides of nitrogen; process safety modifications; usefulness of a hydrogen flame ionization detector; and highlights from 63 air and ammonia plant operators and designers.

Underground Storage

Gas Storage Capacity Climbs—But the Rate of Growth Is Slowing. R. B. Bizal. *Oil Gas J. 59,* 83 (1961) May 8 (7 pp.)

Seventh annual survey of 59 companies indicates that total reservoir capacity will climb to 3.198 trillion CF when projects now under way, testing, or planned are completed. This is a gain of 5.7 percent over the previous year, but falls short of the average annual increase of 13.6 percent for the period 1955-60. Storage facility locations and capacity by state are tabulated.

2. ENERGY SUPPLY AND ECONOMICS

Natural Gas

Natural Gas Recognizes No Barriers. *Oil Gas J. 59,* 104 (1961) Apr. 24 (4 pp.)

Magazine presents the first tabulation of gas reserves of 147 principal gasfields. These tables list the world's 57 major gas areas—those with an estimated ultimate recovery of 1 trillion CF or more, and (by basin habitat), the 90 principal gasfields of North America—those with a cumulative production of 100 billion CF or more.

Natural Gas Whooshes from Infant to Giant in 25 Years. B. W. Beebe. *Oil Gas J. 59,* 98 (1961) Apr. 24 (5 pp.)

In 1935, marketed production of natural gas was slightly less than 2 trillion CF; in 1960, about 11.89 trillion CF reached the consumer. Growth in use of energy is a result of population growth and of a rising standard of living with its increased per capita use of energy. Technology has brought together two basic fundamentals: a sufficient and suitable gas supply, and a sufficient market so that now all major centers of population and industry are connected to sources of natural gas.

Natural Gas, World's Third Ranking Energy Source—A Report on Development and Status of Natural Gas Industries in Natural Gas Producing Countries. III. H. Laurien and G. Wedekind. *Erdol u. Kohle 14,* 221 (1961) Mar. (8 pp. German text.)

Survey is given of natural gas reserves, production, consumption, transport (by pipelines and as liquefied), capital investment, prices, and future development in all major production areas. This part deals with gas in Europe and the Sahara.

Electricity

Ten Ways We Fail to Meet Electric Competition. Our Poor Job of Advertising. C. C. Turner. *LP-Gas 21,* 34 (1961) May (3 pp.)

In continuing his series, author sets forth his views on the difference in advertising techniques employed by the electric and LPG industries. The latter, he believes, lacks forcefulness and originality. He points out that advertising is not confined only to paid commercials on television and in the newspapers, but in the appearance of employees, vehicles and installations; in the handling of customer complaints and inquiries; and in the employees' knowledge of their jobs. While some may call this customer relations, it is still a form of advertising.

Exploration

40 Crucial Years for Gas . . . 20 Down and 20 to Go. P. Bike. *Oil Gas J. 59,* 90 (1961) Apr. 24 (2 pp.)

If the past two decades are used as a gage, the natural gas industry should continue to expand in the next twenty years. Only recently has gas become a prime drilling target rather than a dubious byproduct in the search for crude oil. Some experts believe that the quest

for gas must be stepped up to meet growing demand. Curtailed drilling during the period from mid-1958 through the end of 1960 has resulted in shortening the effective life of domestic reserves.

What's the Secret of Successful Gas Search? *Oil Gas J. 59,* 92 (1961) Apr. 24 (6 pp.)

Editors asked seven experts in the field of exploration this question: Can we evolve a philosophy or an approach to exploration for natural gas in preference to oil? While they do not all agree, their answers do contain a tendency to say "Yes" as a group, if not as individuals.

Fuel Cells

Natural Gas Fuel Cells for Power Generation. E. B. Shultz, Jr., L. G. Marianowski, H. R. Linden and K. S. Vorres. *Am. Gas J. 188,* 24 (1961) May (5 pp.); **Appendix—Guide to Fuel Cell Technology.** *Ibid.,* 29 (4 pp.); **From Fuel Cells—Power for Homes?** *A.G.A. Monthly 43,* 11 (1961) May (4 pp.)

Through the AGA-PAR plan, the gas industry currently is sponsoring research on natural gas fuel cells at the Institute of Gas Technology. Report reviews current progress and related engineering-economic studies, which are directed primarily toward the development of fuel cell power packs for dwellings, to supply all or most of the home needs for electricity. The authors have included an appendix designed to aid in understanding the concept of fuel cells. This appendix includes definitions of terms, an explanation of the functions of cell components, a classification of the many types of cells, and a brief summary of the most significant industrial fuel cell development programs known.

Fuel Cells. C. K. Morehouse, G. S. Lozier and R. Glicksman (assigned to RCA). U. S. 2,976,342 (1961) Mar. 21.

Fuel cell for operation at normal temperatures and pressures is claimed which comprises a reaction chamber and a solid metallic (magnesium or aluminum base) anode that can be introduced into the chamber at a rate corresponding to the rate at which electric power is desired. A solid cathode of organic oxidizable material (such as N, N′ dichloroazodimethylhydantoin) of the group containing nitro, nitroso, azo and positive halogen radicals also is fed adjustably. The electrolyte is a saturated solution of alkali or alkine earth halides which is recirculated to remove the reaction products as current is withdrawn. The cathodic material may be mixed with conducting carbon powder and formed into electrodes.

Heat of Decay Makes Electricity. *Business Week,* 68 (1961) May 6.

Two laboratories are conducting investigations of a so-called biochemical fuel cell that produces electricity from the decomposition of organic matter. One cell uses sugar as a nutrient and bacteria as a catalyst to hasten decomposition; the other uses sea water and bacteria. In each instance, the cell is made up of two sections: an anode section and a cathode section, separated by an ion-diffusion bridge. It is believed by at least one of the developers that before the end of the year, biochemical fuel cells will be made that can turn out a watt of energy.

Gas Turbines

Gas Turbines to Provide Electricity, Heat and Air Conditioning? I. E. Rowe. *Air Conditioning, Heating and Ventilating 58,* 55 (1961) May (5 pp.); **Homemade Electricity: Big, New Market for Gas Men?** R. J. Enright. *Oil Gas J. 59,* 64 (1961) May 1 (3 pp.)

Several gas utilities have had recent experiences with new building designs which utilize few or no windows and high-intensity lighting systems. Since there is little heat loss from a windowless building, a good lighting system can easily furnish enough heat to maintain standard comfort design conditions. When a building uses enough electricity for its lighting to heat during the winter, the power requirements to remove the heat by refrigeration in the summer are quite high. However, if this building could generate its own power for a reasonable cost, and recover enough heat for auxiliary heating and refrigeration requirements, substantial savings would result. This objective can be attained through power generation with gas turbines which recover waste heat for low-pressure steam-operated absorption refrigeration units.

Magnetohydrodynamics

Magnetohydrodynamic Generation of Electric Energy. C. G. Von Fredersdorff. *Power 105,* 66 (1961) May (4 pp.)

Magnetohydrodynamics (MHD) deals with the interactions of electrically conducting streams and magnetic fields. In addition to contributing to a better understanding of celestial phenomena, MHD is of practical interest in high altitude flight, ballistics, propulsion of space vehicles and re-entry problems. It is of importance in problems of plasma motion instabilities encountered in nuclear fusion research. More recently, MHD is considered a potential method for direct generation of electric power from partially ionized gases. Some considerable detail on the nature of the solutions of the MHD equations of motion is already known. The general solution for the three-dimensional case is intractable, and it appears possible to obtain at best only an "approximate" solution involving first order interactions for the steady-state, frictionless one-dimensional flow system with orthogonal geometry. This approach is used to arrive at an engineering analysis of the potential power capacity and efficiency of an MHD device operated with high-temperature gases.

Small MHD Power Generator Using Combustion Gases as an Energy Source. G. J. Mullaney and N. R. Dibelius. *ARS J. 31,* 555 (1961) Apr. (3 pp.)

Small MHD channel was used to investigate the fundamental principles of this method of power generation. In the experiments described, the potassium concentration was varied from 1-6 percent by weight of the combustible mixture. The power output of the genera-

tor increased as the square root of the potassium concentration, following the trend established in conductivity experiments performed earlier. The output power was 55 percent of the calculated value. Power extraction was transverse to both magnetic field and gas flow, and continuous electrodes were employed.

Petroleum Development

Rebels and Oil in Algeria. *World Petrol. 32,* 42 (1961) Apr. (2 pp.)

Independent Algeria will mean a review of existing concession contracts in the French Sahara. Leaders of the Algerian nationalists in New York express their willingness to go along with existing international practice in the field of oil concessions. They are accumulating oil experience and have several representatives studying the oil industry in the United States and other countries.

Petroleum Production

A Review of 1960 Domestic Production. R W. Miller. *J. Petrol. Tech. 13,* 319 (1961) Apr. (2 pp.)

In summarizing U. S. production, author paints a rather sobering picture caused by only a 2 percent increase in demand for petroleum products. He suggests re-evaluating the estimated total productive capacity of existing wells, with the thought that many may be overrated.

A Review of Foreign Oil Production in 1960. Z. Mayhew. *J. Petrol. Tech. 13,* 320 (1961) Apr. (3 pp.)

Author concludes that the year was one of adjustment to the continued problem of overcapacity to produce. He points out that definite strides were made during the year toward healthy adjustment—including more realistic approaches to drilling, exploration, capital expenditures and refinery runs.

The Soviet Seven-Year Plan (1959-65) for Oil. D. J. Frendzel. *U.S. Bur. Mines Inf. Cir. 8023.* (Washington, D.C.: U.S. Dept. of the Interior, Bureau of Mines, 1961; 17 pp. with separate map.)

Rapid growth of Soviet petroleum production will allow the USSR to displace Venezuela as the world's second largest oil producer in 1960, and to further narrow the gap between Soviet and United States crude oil production. USSR crude oil output was only a tenth of U.S. production in 1946, but it will be more than a third at the end of 1960, and more than half in 1965. Seven-year plan for oil provides for substantial increases in petroleum production, refining, storage, and distribution facilities. Crude oil production and primary distillation capacity are to double, considerable storage capacity is planned, and pipelines for crude oil and petroleum products are to increase threefold.

Petroleum Refining

Catalytic Reforming. F. G. Ciapetta. *Petro/Chem Eng. 33,* C-19 (1961) May (13 pp.)

Author reviews the development of catalytic reforming, touching upon such subjects as naphtha reforming catalysts, commercial catalysts and process variables.

3. NATURAL GAS AND PETROLEUM PRODUCTION

Drilling

Drilling-Cost Charts—A Field-Level Approach to Cheaper Wells. V. Edelberg. *Oil Gas J. 59,* 102 (1961) Apr. 17 (4 pp.)

Drilling-cost charts presented, combined with close examination of the dull bits, show cost and performance on a bit-by-bit basis with full allowance for local conditions. Charts provide means for determining bit life, proper bit weight and optimum rotary speeds.

New Dual-Weight Drill Pipe Turns in Good Performance. E. McGhee. *Oil Gas J. 59,* 98 (1961) May 1 (2 pp.)

Drilling contractors can now buy a drill pipe that has most of the advantages of the thin-wall pipe without many of its disadvantages. The new pipe has thin-wall sections through most of its length. However, the last 4-6 feet on the box end is thicker. Result is that a string of the pipe is light but is not subject to the crushing, bottlenecking, notching and bending in the slip area as is ordinary, lightweight drill pipe.

Exploration

Black Mesa Basin—It's a Prime Gas Target for Tomorrow. D. S. Turner. *Oil Gas J. 59,* 148 (1961) Apr. 24 (3 pp.)

Black Messa basin covers essentially the entire northeast quarter of the State of Arizona. The numerous gasfields known in the vicinity of the basin are located principally around the north (near the Utah-Arizona state line) and east (near the Arizona-New Mexico line) rims. To date, slightly more than 100 wells have been drilled; 32 tests, or approximately 30 percent, have had some indications of gas.

Deep Frio Yields a "Golden Gas Lane" . . . Along the Texas Coast. N. Williams. *Oil Gas J. 59,* 124 (1961) Apr. 24 (2 pp.)

Among the Frio (Texas) fields ranking among the top gas producers and reserves are Old Ocean, Chocolate Bayou, Alta Loma, Seeligson, Red Fish Bay, Greta-Tom O'Connor, Stratton, Agua Dulce, and La Gloria. Despite the large number of fields found in it, the Frio trend remains a prime source for new exploration. Most intensive development has, and still is, centered in Matagorda County and bordering areas of Jackson, Calhoun, Brazoria, and southern Wharton counties. In Matagorda County alone, more than 15 entirely new gasfields have been found within the past year.

Depth Makes a Difference in the Search for Natural Gas . . . as Incentives Shift from Oil. C. M. Allen. *Oil Gas J. 59,* 103 (1961) Apr. 24.

Phillips Petroleum Co. has adapted its exploration budget to allot definite sums for gas search, other sums for oil. Its experience through 1959 reveals that more than 50 percent of its exploratory expenditures went to gas, and preliminary 1960 figures indicate an even greater portion in this direction.

East Texans Dance the "Jurassic Jump." R. W. Eaton. *Oil Gas J. 59,* 114 (1961) Apr. 24 (4 pp.)

Success of Jurassic exploration in Northeast Texas during 1960 gave the first promise of industrywide profit in 23 years of effort. Twenty exploratory tests were drilled, and seven resulted in new Jurassic discoveries; five were from the Smackover and two from the Cotton Valley.

Gas Is Major Target for Explorers in the Green River Basin. W. W. Skeeters. *Oil Gas J. 59,* 152 (1961) Apr. 24 (4 pp.)

Green River basin, by original definition, is bounded by the Overthrust belt on the west, the San Madres Mountains and the Rawlins uplift on the east, the Wind River and Gros Ventre mountains on the north, and the Uinta Mountains and axial basin anticline on the south. This major intermontane basin covering some 21,000 square miles in Wyoming, Utah and Colorado, is subdivided by the Rock Springs uplift. Author describes features that combine to make this basin an attractive province for future exploration. He predicts that the steady development of the past few years will continue into the future.

Gas Prospects Underlie the Revival of Pennsylvania. *Oil Gas J. 59,* 119 (1961) Apr. 24 (3 pp.)

All of Pennsylvania's 1960 discoveries were the result of deep exploration. Efforts produced one new gasfield and nine gas pools. Last year, 126 deep wells were completed; of these, 74 were gaswells and 52 were dry holes. Of the gaswells, 61 were development wells, 1 was a successful new-field wildcat, 8 were successful new-pool wildcats, 1 was a successful deeper pool test, and 3 were successful outposts. Total footage of the deep wells amounted to 851,347 feet.

In California: Sacramento Valley Turns Up More Gas Strikes. C. J. Lawrence. *Oil Gas J. 59,* 144 (1961) Apr. 24 (3 pp.)

California's Sacramento Valley is continuing to earn its reputation as a growing gas province. During the first three months of 1961, the valley has turned up three new fields, along with one fault-block discovery and three new pools. Two counties—Sutter and Colusa in the middle of the valley—have grabbed all the significant successes so far this year. One geologist predicts that the big future of the valley is in the deep zones between 10,000-15,000 feet.

Northeast Thompsonville . . . A Typical Case History of a Deep Wilcox Field. A. W. Wood. *Oil Gas J. 59,* 111 (1961) Apr. 24 (2 pp.)

Field is located principally in the northwest corner of Jim Hogg county, Texas, and the adjacent area to the north in Webb county. When the field is fully developed, it is possible that the productive area will extend into Zapata county to the west and southwest of present production. The productive Wilcox sand is of Eocene age. Through February 1961, 14 gaswells had been completed. Currently, there are 8 drilling or projected wells.

Oil Finders Making Long Drives on Arkoma Basin's "Fairway." R. N. Planalp. *Oil Gas J. 59,* 126 (1961) Apr. 24 (3 pp.)

Arkoma basin, astride the Oklahoma-Arkansas border, consists of four geological areas. Article is concerned with the "fairway," scene of most current drilling. The higher well density in this area has resulted in sufficient subsurface control for most wells to be accurately correlated, especially in the Arkansas portion where deposition of Atoka sediments apparently was more uniform. The Atoka formation ranges from 2500-9000 feet in this area.

On the Composition and Origin of the Zechstein Gases in Northwest Germany. H. U. Hark. *Erdol u. Gas 14,* 174 (1961) Mar. (6 pp. German text.)

In the Zechstein, there are basin regions or zones which are distinguished by their high proportion of a certain gaseous component. It has become possible to detect one CO_2, one CH_4, and one N_2 gas province. The origin of natural gases and the different causes for their composition are discussed. It is important to have some knowledge of the regional distribution of the different gaseous components (i.e., hydrocarbons, nitrogen, carbon dioxide and hydrogen sulfide) not only for exploration in general, but also for possible gas emanations in salt mines.

Where Gas Search Is Deep, Expensive, and Rewarding. W. D. Thorn. *Oil Gas J. 59,* 140 (1961) Apr. 24 (3 pp.)

As the search for new oil reserves was pushed slowly into the Delaware and Val Verde basins westward and south of the Permian basin oilfields, it was established that the Pennsylvanian, Devonian, and Ordovician formations, so productive of crude oil in the Permian basin area, were very gassy in the deep and expensive wells in the Val Verde-Delaware region. Coincident with the realization that great gasfields probably existed throughout the Val Verde-Delaware, the market demand for gas—and gas reserves—skyrocketed. Surging demand furnished incentive for big gas transmission companies to build lines into the new areas.

Logging

Application of Computers to the Interpretation of Well Logs. V. S. Tuman and D. Bollman. *J. Petrol. Tech. 13,* 311 (1961) Apr. (8 pp.)

After explaining the procedure by which computers can be used to interpret well logs and after describing the various digitizing units currently available, article demonstrates a method of writing a program for a digital computer with a step-by-step example. Some examples processed on the computer for the formations in the Illinois basin also are included.

Mud Analysis Logging. B. O. Pixler. *J. Petrol. Tech 13,* 323 (1961) Apr. (4 pp.)

Various mud gas separators and gas detectors are compared. Emphasis is placed on a new technique of measuring quantitatively the volatile hydrocarbon components in drilling mud.

Reservoir Engineering

The Use of Alternating Flow to Characterize Porous Media Having Storage Pores. C. R. Stewart, A. Lubinski and K. A. Blenkarn. *J. Petrol. Tech. 13,* 383 (1961) Apr. (7 pp.)

Authors discuss core tests to determine the fraction of porosity comprised of storage pores and the degree of restricted access into such pores. Article suggests that such restrictions affects some displacement processes.

Well Practice

Status of Drill-Stem Testing Techniques and Analysis. H. K. Van Poollen. *J. Petrol. Tech. 13,* 333 (1961) Apr. (7 pp.)

Author outlines the latest in drillstem testing techniques, tools and interpretation methods, and discusses the merits and disadvantages of each. He makes a number of suggestions for future development, and presents an extensive list of references for use on future DST studies.

4. GAS CONDITIONING AND LPG RECOVERY

Dust

Development and Preliminary Testing of a Device for Electrostatic Classification of Submicron Airborne Particles. G. Langer and J. L. Radnik. *J. Appl. Phys. 32,* 955 (1961) May (3 pp.)

Practical apparatus was developed for electrostatic size classification of aerosol particles of 0.1 to a few microns in diameter. The aerosol, surrounded by a sheath of clean air, is charged by passing it closely over an intense positive discharge at high speed. Charging rates several times above those predicted by conventional theory permitted good resolution. A high natural charge on the aerosols had an adverse effect on classification. Various aerosols were examined, and results of practical significance were obtained.

Gas Conditioning

Bibliography on Gas Conditioning. L. M. Van Der Pyl. Paper No. CEP-61-2. (New York: American Gas Association, May 1961; $0.25)

During the period 1950-60, some 93 publications of importance in the field of gas conditioning were added to the literature. These are reviewed by the author.

Hydrocarbon Removal

Adsorption Unit Recovers 99.6% Pentanes-Plus. G. F. Russell. *Petrol. Refiner 40,* 103 (1961) Apr. (4 pp.)

New natural gas processing unit at Conoco's Driscoll plant recovers 99.6 percent of the pentane-plus fraction by the Liquigen process. This process automatically and alternately uses both steam and hot gases for regenerating activated carbon and activated alumina. It produces an effluent gas, denuded of both water and heavier hydrocarbon liquids. After nine months of operation, bed activity shows no loss.

Benton Plant: How It Was Changed. J. J. Weatherby. *Petrol. Refiner 40,* 113 (1961) Apr. (4 pp.)

Benton plant of Sunray Mid-Continent Oil Co. has been modified from a simple cycling plant to a gas liquids plant recovering 80 percent propane. To do this, refrigeration equipment was added; new steam, electric and absorber loads had to be satisfied. Article describes methods used to engineer these problems.

Hydrogen Sulfide Removal

Hot Carbonate Plants: How Pressure Affects Costs. H. E. Benson. *Petrol. Refiner 40,* 107 (1961) Apr. (2 pp.)

Operating pressure is important in determining installation costs for hot potassium carbonate plants, used to remove carbon dioxide from natural and synthesis gases. According to this new design and cost study, pressure ranks with inlet and outlet acid gas content as a major factor. This study extends the investment costs data developed by the Bureau of Mines (see *Gas Abstracts 16,* 78), where the system pressure was 350 psig.

Modern Trends in Gas Purification. J. J. Priestley and W. E. Bouch. *J. Ind. du Gaz 85,* 97 (1961) Mar. (8 pp. French text.)

New dry and liquid purification processes appeared in Great Britain (iron oxide purifier with rapid rotations recently commissioned at Southampton). Greater gas drying is required for its pressure transmission through welding steel mains based on refrigeration at Lostock Hall works. Authors also discuss catalytical Holmes Maxted organic sulfur removal plant at Jersey.

Natural Gas Purification by the Hot Carbonate Process. H. E. Benson. Paper No. CEP-61-6. (New York: American Gas Association, May 1961; $0.25)

Prior to the 1930's, the wet, regenerable processes employed for removal of H_2S and CO_2 were limited to circulating ambient temperature carbonate solutions and also water washing when sufficient pressure existed. During the 1930's, the Girbotol process using mono-, di-, or tri-ethanol amine solutions was developed, replacing earlier processes. This was due to the higher rates of absorption of H_2S and CO_2 and lower steam consumption when compared with cold carbonate solutions. The main advantages of the amine scrubbing process over water scrubbing were in lower capital costs and gas losses due to physical solution of the product gas in the water. Paper discusses the use of the hot carbonate process as applied to natural gas purification with reference to other processes where appropriate.

Recover Sulfur with Zeolites. H. W. Haines, Jr., G. A. Van Wielingen and G. H. Palmer. *Petrol. Refiner 40,* 123 (1961) Apr. (4 pp.)

Bench scale and pilot plant tests show gas sweetening and sulfur recovery using synthetic alkali metal aluminosilicate zeolites to be practical and economical.

Article describes test equipment and includes some statistical data.

Nitrogen Removal

Nitrogen Removal: Its Costs and Profits. D. B. Jameson and L. R. Mann. *Petrol. Refiner 40,* 121 (1961) Apr. (2 pp.)

Natural gas with high nitrogen content can be upgraded to a product heating value of 950 Btu/SCF with this cryogenic process. Study shows how costs and profits for this process vary with plant capacity, feed gas pressure and nitrogen content. Profits are based on a $0.35/MCF gas sales price.

Nitrogen Oxide Removal

Method of Selectively Removing Oxides of Nitrogen from Oxygen-Containing Gases. J. G. E. Cohn, D. R. Steele and H. C. Andersen (assigned to Engelhard Industries, Inc.) U.S. 2,975,025 (1961) Mar. 14.

Process for removing small amounts of nitric oxides from oxygen-containing gas is claimed. This comprises reduction of NO and NO_2 by adding ammonia to the gas stream, and passing the stream over a platinum-group metal catalyst at 150°-400°C. A selective reaction with nitrogen oxides occurs in more effective degree than with CH_4, H_2 or CO as reductants.

Sulfur Production

Boom in Canada's Processing Centers on Gas and Sulfur. W. C. Uhl. *World Petrol. 32,* 48 (1961) May (4 pp.)

In the past year, Canada added 16 new gas processing plants to her industry. Current projects underway or definitely planned total thirteen and three expansions of existing plants. A very large increase in sulfur production will result from these various gas processing plants. Total sulfur capacity will rise by about 3291 ton/day (153 percent), to 5440 ton/day when the plants go on-stream. Canadian sulfur reserves had risen by 4,330,000 long tons as of December 31, 1960.

Recovered Sulfur's Impact on Market Is Growing. H. Pylant. *Oil Gas J. 59,* 70 (1961) Apr. 17 (2 pp.)

Sulfur market, once supplied primarily from Frasch sulfur mines along the U.S. Gulf Coast, now comprises recovered sulfur as well. Currently, there are 65 sulfur recovery plants in the United States with a total capacity of about 4600 long tons/day; others are planned. Production costs are discussed.

Sulfur Removal

Gasoline Sweetening Process with Molecular Sieves. K. H. Bacon and A. M. Henke. *Petrol. Refiner 40,* 109 (1961) Apr. (4 pp.)

Adsorption-regeneration cyclic process using molecular sieves has been developed for desulfurizing natural gasoline. The process is effective in extensive desulfurization and is noncorrosive. Authors present the effects of operating variables that lead to the design of a 300,000-gallon/day commercial unit.

5. NATURAL GAS TRANSMISSION

Automation

Pipeline Companies Spend Heavily for Automation. *Petrol. Week 12,* 44 (1961) Apr. 21 (7 pp.)

Between 60 and 80 percent of this year's expenditures on improvements by the pipeline industry will be for automation. This indicates an increasing reliance by the industry on automation as a tool to decrease costs and increase efficiency. Crude and products pipelines are ahead of gaslines in automation, for the reason that pump stations—because they are smaller—are easier and less expensive to put on remote or local automatic control.

Look What's Happened in Push-Button Pipelining in Just 5 Years. F. S. Jones. *Oil Gas J. 59,* 116 (1961) May 1 (8 pp.)

In 1956, very few companies were using automation for unattended operational control pumping stations. In 1960, remote and automatic control had advanced to 37 percent, unattended operation to 22 percent, and partially attended operation to 21 percent. Areas of advancement include remote switching, hydraulic control, area station maintainer, automatic welding and induction welding.

Compressors

Water-Spray Keeps Compressors Clean. W. Coopey. *Chem. Eng. 68,* 106 (1961) May 1 (4 pp.)

Introducing water into compressor cylinders can wash out the fine dust that resists most other dust-removal methods, says author. Higher output and lower maintenance costs should result.

Compressor Stations

Influence of Fluctuations of Pressure in Pipe-Conduit Systems on the Work of Self-Acting Valves of Piston Compressors. G. V. Karpov. *Nauchno-Tekhn. Inform. Byul. Leningrad Politekhn. In-ta* 16 (1958) No. 3 (8 pp. Russian text); *Ref. Zh. Mekh.* No. 9, 1959, Rev. 9981. [From *Appl. Mech. Rev. 14,* 306 (1961) Apr.]

It is shown that pulsations of the gas in the pipe conduits of compressors may influence the work of self-acting valves by inducing repeated opening. The productive capacity of the compressor is practically not changed thereby, but the stress on the work of the valves is magnified, as the return to the seating of the valve is accompanied by a blow.

S. M. Il'yashenko
Courtesy Referativnyi Zhurnal, USSR

Engines

Save Fuel by Controlling Variables. E. Kelgard. Part 1. *Oil Gas J. 59,* 128 (1961) Apr. 17 (3 pp.); Part 2.

Maintenance Pays Off for Dual-Fuel Engines. *Ibid.,* 127 (1961) May 1 (6 pp.)

Author discusses operation of dual-fuel engines in pipeline service. He points out that fuel savings of up to 20 percent are possible through the proper control of variables affecting the operation of dual-fuel engines: combustion-air quantity, charging-air temperature and timing and quantity of pilot oil. In the second part, he is concerned with good maintenance practices, and points out that good fuel economy generally results in reduced maintenance costs.

Pipeline Construction

New Gas Pipeline Spurs Uinta Basin Exploration. J. C. Osmond. *Oil Gas J. 59,* 130 (1961) Apr. 24 (3 pp.)

By the end of 1961, gas will be flowing through a new pipeline across the Uinta Utah basin. Mountain Fuel Supply Co. is constructing this 94-mile line to carry 100 MMCF/day of gas from the large proved reserves in the eastern part of the basin. The line will cross the basin and connect with the Utah Natural Gas Co. pipeline near Clear Creek gasfield. The gas will be sold in the Provo-Salt Lake City-Ogden area where there is a large demand by smelting and industrial users.

Pipeline Operations

New Cleaning Method Avoids Damage to Internal Coating. D. C. Palm. *Pipeline Eng. 33,* D-26 (1961) May (2 pp.)

Natural Pipeline Company of America's plan for line cleaning is a combination of removing foreign matter by blowing to sweep out excess loose material, then passing a pig one or more times to dislodge remaining foreign matter, and subsequently blowing again to assure a clean line. This procedure was developed to avoid possible damage to the interior coating. Conventional spring-loaded brush pigs were modified for this operation.

Trunkline Reports on Low-Cost Sandblasting that Increases Gas Flow. Part 1. A. W. McAnneny and L. C. Sullivan. *Pipe Line Ind. 14,* 40 (1961) May (6 pp.)

By blowing sharp sand through a pipeline using natural gas as motive power, the interior of the pipe can be cleaned, smoothed and polished. The result is an appreciable increase in "E" factors. This technique, developed by Trunkline Gas Company (Houston, Texas) engineers, probably provides the most efficient, practical way to increase capacity on many gas transmission systems. In the first of two parts, authors describe preliminary work in this field, and the means used to extrapolate to estimate its effect on large-diameter pipe.

Telemetering

Instrumentation, Controls, and Automation. Part 6. Telemetering. M. T. Nigh. *Pipeline Eng. 33,* D-31 (1961) May (3 pp.)

Author analyzes digital telemetering message to determine contents. Basically, any message is considered complete when it contains three parts: 1) identification, or address of the data; 2) the data itself; and 3) additional data concerned with validity or verification of the data. These components are discussed.

6. GAS AND LPG STORAGE

LPG Storage

Process and Economics of Storing Propane. F. J. Maslyk. Paper No. CEP-61-3. (New York: American Gas Association, May 1961; $0.25)

Expanding use of natural gas for household and industrial purposes, coupled with the attractive possibilities of manufacturing organic chemicals, has produced a constantly increasing demand for propane. Since the consuming centers are often widely separated by land or water from the production centers, suitable transportation of propane must be effected. This is usually performed by pipeline, railroad, tank cars, tank trucks or barges. More recently, serious consideration is being given to the use of ships. Such transportation requires adequate terminal storage facilities at the consuming as well as at the production centers. Paper presents some of the process and design considerations as well as the comparative economics involved in the storing of liquid propane at near atmospheric pressure, medium pressure and at high pressure.

Economy and Safety Make Underground Storage Ideal for LPG. G. P. Jennings. *Oil Gas J. 59,* 106 (1961) May 1 (4 pp.); **Underground Storage Operations for LPG.** *Pipe Line Ind. 14,* 66 (1961) May (3 pp.)

Article assimilates opinions of more than 50 operators of underground storage on the three types available: conventionally mined caverns in impervious rock solution-mined cavern in salt dome; and solution-mined cavern in salt bed. Salt-bed caverns frequently present some costly operating problems, but, in most cases, the high operating costs can be justified by the low initial costs. Operating problems in mined and salt-dome caverns appear to be very nominal according to the author's findings.

The Storage and Handling of P.F.D. and L.P.G. A. G. Palmer. *Gas J. 306,* 54 (1961) Apr. 12 (6 pp.)

Light distillates and liquid petroleum gases are now being used (in Great Britain) at an increasing rate on water gas plants, in retort houses, and finally on specially designed plant for reforming at high efficiency. Thus, the gasworks is rapidly approaching the condition of an oil refinery, but an equally rigid control for safety on the works is less easily applied. Because light petroleum distillates are within the Petroleum Consolidation Acts 1928, safety measures in their handling and storage can be enforced by law. However, LPG is not within this scope. Author outlines precautions in handling these products.

Methane Liquefaction

Method of Distribution of Condensable Gases. H. O. McMahon (assigned to Arthur D. Little, Inc.) U.S. 2,975,604 (1961) Mar. 21.

Method for making a condensable natural gas available at a location remote from a source is claimed. Method comprises liquefying the gas, transporting it in insulated

tanks to a remote point, and removing and vaporizing the liquefied gas to produce refrigeration. The refrigeration is used in liquefying air at this remote point, and the separated liquid nitrogen so produced is sent to local storage. As soon as the transport tanks have been emptied, they are immediately filled with liquefied nitrogen from storage. Thus, the transport tanks are maintained in cold condition, and the nitrogen can be used for refrigeration at the well source of natural gas.

Reliquefaction System for Liquefied Gases. A. Pastuhov (assigned to Conch International Methane Ltd.) U. S. 2,978,876 (1961) Apr. 11.

Vaporized gas from a multiple-tank liquefied gas storage plant is recovered by a condensation system. The vapor is passed to closed circuit coils in a cold liquid bath and is liquefied and returned to its storage. The cooling bath is left refrigerated by compressing, cooling and expanding its boil-off vapor, and also by maintaining its pressure below that of the stored liquefied gases.

Refrigerated Storage

Refrigerated Storage Facilities. J. T. Horton. *LP-Gas 21,* 28 (1961) May (4 pp.)

Key to efficient, economical storage of liquefied gases is refrigerated vessels, states author. Constant control of product temperature allows refrigerated tanks to be designed for lower pressures and correspondingly lower cost. Saving on steel far overshadows the cost of insulation and refrigerating equipment needed for low-temperature storage. Discussion is intended to provide basic information about refrigerated storage between +32°F and —50°F of liquefied gases such as butane, propane and anhydrous ammonia.

Underground Storage

Planning Underground Storage in Canada. R. P. Charvonnier. *Gas Age 127,* 39 (1961) Apr. 27 (4 pp.); **Underground Storage of Natural Gas.** *Gas World 153,* 601 (1961) Apr. 29 (4 pp.)

Current and projected growth in demand for natural gas in the major consuming areas of Canada is expected to make underground storage facilities as important in solving irregular consumption problems and winter peak demands in that area as these facilities have been in the supply and marketing situation of the United States. Author reviews the position and prospect in this respect.

Forming Subterranean Cavities by Solution Mixing. R. C. Allred, D'A. Shock and J. D. Sudbury (assigned to Continental Oil Co.) U. S. 2,976,690 (1961) Mar. 28.

Improved method is claimed for forming a subterranean storage cavity in a deep salt formation, in which the size and shape of the cavity is controlled. This comprises providing a concentric casing inlet and outlet for the water to the base of the salt bed. Water, introduced through the inlet nozzles arranged horizontally at the bed level, removes and recirculates the brine from the forming cavity until it is saturated. A measured amount of water is used, thus limiting the size of the cavity below the brine outlet. The saturated brine is allowed to remain in the cavity, and casings are raised above the brine level. This process is repeated with fresh amounts of water to form a series of vertically connected cavities. When formation height is reached, the brine is pumped out to give storage space for other liquids.

Semi-Automated LPG Cavern—Process Plant. W. J. Schreiner. Paper No. CEP-61-10. (New York: American Gas Association, May 1961; $0.25)

Installation described comprises essentially an underground cavern for low-cost propane storage adjacent to a propane pipeline to minimize feedstock transportation costs; and a neighboring process plant adjacent to a gas transmission system to minimize transportation cost of the final product. The propane-air process plant is large and operates at high pressure; the installation is complete with semi-automatic controls for the reception of feedstock, the determinations of storage capacity, the pumping of propane from the cavern to the plant, the operation of component plant units, and the control of overall deliveries and heat values into the transmission system as necessary for system requirements. Author describes the design, construction and operation of the propane cavern—process plant and its special features.

7. MANUFACTURED GAS AND CHEMICAL PROCESSING

Acetylene

Producing Acetylene in a Plasma Jet. H. W. Leutner and C. S. Stokes. *Ind. Eng. Chem. 53,* 341 (1961) May (2 pp.)

By using a plasma jet, it is possible to convert methane nearly completely into acetylene. The acetylene produced is easily separated from the argon carrier and the hydrogen, produced as a byproduct of the reaction. The only product thermodynamically possible, in the experiments described, is acetylene.

Adsorption

The Absolute Adsorption Isotherms of Vapors of Nitrogen, Benzene and *n*-Hexane, and the Heats of Adsorption of Benzene and *n*-Hexane on Graphitized Carbon Blacks. I. Graphitized Thermal Blacks. A. A. Isirikyan and A. V. Kiselev. *J. Phys. Chem. 65,* 601 (1961) Apr. (7 pp.)

Unified absolute isotherms for nitrogen at −195°C and *n*-hexane at 20°C have been measured using a series of "graphitized" medium thermal carbon blacks as adsorbents. Differential heats of adsorption as a function of surface coverage also were measured. The initial portion of the nitrogen isotherms is slightly convex and well-described in terms of localized adsorption, taking into account interaction of adsorbate molecules. The adsorption isotherm for benzene, on the other hand, is

initially concave, and the heat of adsorption is found to be practically constant over the entire monolayer coverage. In the case of *n*-hexane, the heat of adsorption rises by about 15 percent during monolayer coverage, and the initial portion of the isotherm, like nitrogen, is slightly convex. The newly measured heats of adsorption are in good agreement with earlier calculated values of the potential energy of adsorption.

The Kinetics of Absorption and Evolution of Hydrogen by Palladium and Palladium/Platinum Electrodes. T. B. Flanagan and F. A. Lewis. *J. Electrochemical Soc. 108,* 473 (1961) May (5 pp.)

Kinetics of absorption and desorption of hydrogen by palladium and a series of palladium/platinum alloy electrodes have been examined in hydrochloric acid solutions near their equilibrium hydrogen contents (1 atm H_2:25°C). The kinetics have been correlated with previous studies of absorption where the desorption rate could be neglected.

Aromatics

Low-Sulphur Benzene. W. M. Hyslop, W. A. P. Carter and E. Marsden. *Coke and Gas 23,* 142 (1961) Apr. (4 pp.)

Production of low-sulfur benzene at Appleby-Frodingham (Great Britain) using conventional methods is described. Investigations have shown that the ideal washing time for the production of low-sulfur benzene is only slightly longer than that required for production of nitration grade benzene. Since October 1960, the company has been producing their total output of 50,000 gallons/week, with a total sulfur content below 2 ppm w/w without a single off-test despatch. This has been achieved by acid washing in conventional batch washers.

Recent Trends in Aromatic Chemicals from Petroleum. R. Landau. *World Petrol. 32,* 56 (1961) Apr. (7 pp.)

Petroleum has emerged as the dominant source for aromatic chemicals. It now exceeds all other raw materials as a source for benzene and has been ahead of other sources for toluene and xylenes since 1950. And, although naphthalene has been produced entirely from coal tar, there are now facilities under construction which will greatly reduce the percentage of total production coming from coal tar.

Carbon Black

A Look at Carbon Black. E. Dannenberg. *Can. Chem. Processing 45,* 81 (1961) Apr. (5 pp.)

Physical and chemical properties of carbon blacks influence their interaction and behavior with elastomers, both in vulcanized and unvulcanized combinations. The properties known to have a definite effect on rubber behavior are particle size and porosity, primary particle aggregation and the chemical nature of the particle surface. Author investigates the many complexities of the carbon black structure and explains both its chemical and physical characteristics.

Catalysts

Infrared Studies of Carbon Monoxide Chemisorbed on Nickel and on Mercury-Poisoned Nickel Surfaces. J. T. Yates, Jr. and C. W. Garland. *J. Phys. Chem. 65,* 617 (1961) Apr. (7 pp.)

The infrared spectrum of CO chemisorbed on alumina-supported Ni surfaces has been investigated in the region from 1700-2400 cm^{-1}. Full coverage spectra clearly show that the character of the Ni surface is a function of the Ni concentration; Ni surfaces ranging from a compact crystalline type to a dispersed type have been observed.

Coal Carbonization

Correlation of Fischer-Schrader Assay and BM-AGA Carbonization Yields. J. G. Walters. *U.S. Bur. Mines Rep. Invest. 5780.* (Washington, D.C.: U.S. Govt. Print. Off., 1961.)

Test methods for the carbonizing properties of American coals were established in 1928 by the Bureau of Mines (BM) and the American Gas Association (AGA). To check results, the coals were also tested by a modified Fischer-Schrader low-temperature assay, which was discontinued after data were obtained on approximately 100 coals. However, industries continued to use the Fischer-Schrader method, ignoring the BM-AGA standard. Correlation results indicate that BM-AGA yields of coke, tar, light oil, gas and liquor can be calculated from Fischer-Schrader assay data. This extends the worth of the current BM-AGA survey of the carbonizing properties of American coals by allowing comparison with a larger number of coals and also with industrial data.

Coal Gasification

Gasification of Fuel Dusts under Pressure. D. Yu. Gomburg. *Gazovaya Prom. 6,* 13 (1961) No. 2 (7 pp. Russian text.)

Review and discussion of published results of experimental work is given. The Texaco, Bureau of Mines (Morgantown), Institute of Gas Technology and the Gaz de France Bianchi processes are outlined; methane yields and thermal efficiencies are compared.

The Ninth Coal Science Lecture. Methane from Coal. F. J. Dent. *BCURA Quarterly Gaz.,* 1 (1960) No. 42 (14 pp.)

Author reviews the theory and practice of methane formation during carbon gasification. The Lurgi process is discussed. Gas purification to raise hydrogen content, two-stage and fluidization processes, and hydrogenation equilibrium at various temperatures are reviewed. Results of laboratory and pilot plant were discussed, and compared with foreign research.

Ethylene

Removal of Carbon Monoxide from Ethylene. W. B. Green and V. E. Gaede (assigned to Phillips Petroleum Co.) U.S. 2,973,628 (1961) Mar. 7.

Method of removing carbon monoxide from an impure ethylene stream is claimed, in which the impure ethylene is fed into a fractionation zone operated at 315 psia and at bottom and overhead temperatures of −15° and −16°F, respectively. The overhead column, containing all the CO, is cooled to −25°F, condensed, and part of the condensate is used as reflux in the upper zone of the column. The liquid bottoms are substantially pure ethylene, which is heat exchanged with incoming feed and also is used to heat the kettle.

Fluidization

Gas Residence Time in Fluidized Beds. A. R. Huntley, W. Glass and J. J. Heigl. *Ind. Eng. Chem. 53,* 381 (1961) May (3 pp.)

Appreciable insight into the flow patterns existing in a fluid solids system can be obtained from the gas residence time distribution. Details are presented on the overall technique and of the equipment developed to handle the tracer injection, tracer detection, and data reduction problems encountered in both small and very large fluid solids pilot units. Typical results from both units are presented.

Hydrogasification

Rich Gas from Petroleum Distillate. J. G. King. *Coke and Gas 23,* 146 (1961) Apr. (4 pp.)

Recent report (see *Gas Abstracts 16,* 198) from the Institute of Gas Technology (IGT) discloses that IGT has developed to an advanced pilot stage a research project for the manufacture of a substitute gas from liquid petroleum fractions. Author believes that the report would be worthy of study in Great Britain in view of the advances which are in prospect in the field of complete gasification. Author briefly describes the hydrogasification process detailed in the report, emphasizing those sections which may be of particular interest to the British gas industry.

Hydrogen

Process for Purifying Technical Hydrogen. P. J. Haringhuizen (assigned to Stamicarbon N.V.) U.S. 2,975,605 (1961) Mar. 21.

Process is claimed for purifying technical hydrogen from nitrogen, carbon monoxide and argon by first cooling the stream to below the condensation temperature of the impurities so that these are deposited as liquid. The residual impurities are removed as solids by further cooling in a heat exchanger. The solids are removed by a flushing stream of colder purified hydrogen, the improvement comprising the use of higher pressure in the flushing stream.

What's New in Steam Methane Reformers. M. R. Kitzen and J. Tielrooy. *Petrol. Refiner 40,* 169 (1961) Apr. (6 pp.)

Catalytic steam reforming of light hydrocarbon gases, known more commonly as steam methane reforming, is the most widely used method of producing hydrogen. Recent improvements in this method have reduced the cost of building plants, and have substantially reduced the cost of hydrogen production. These cost reductions have been achieved by carrying out the steam methane reforming operation at higher pressures, and by operating the steam methane reforming furnaces with higher heat flux densities, higher space velocities, and higher tubeskin temperatures.

Naphthalene

First Petrochemical Naphthalene. N. P. Chopey. *Chem. Eng. 68,* 68 (1961) May 1 (4 pp.)

Three licensees are already using Ashland Oil & Refining's (Catlettsburg, Ky.) Hydeal process to make petrochemical benzene. Moreover, Ashland's manufacture of naphthalene is the first real breakthrough in freeing phthalic anhydride producers from dependence on coal-tar sources of this basic intermediate. Feed to the petronaphthalene unit is the heavy fraction of a catalytic reformate. This is catalytically hydrodealkylated to yield naphthalene of outstanding purity.

Oil Gas

A Study of Automation as Applied to High Btu Oil Gas Production. G. S. Daves. Paper No. CEP-61-8. (New York: American Gas Association, May 1961; $0.25)

Gas production optimization accomplished by computer control is expected to effect lower utility costs in addition to the increased efficiencies of conversion and manpower utilization, says author. Problems that may arise in the course of applying a digital control system to a new process can best be solved by a careful analysis of the process and of the possible control systems that may be employed. Author discusses system analysis, system planning and design, and specifically describes the economics, maintenance and system details of the Paterson (N.J.) plant of the Public Service and Electric and Gas Company.

Automatic Operation of Cyclic Gas Making Plant. A. Stubbs. *Gas World 153,* 542 (1961) Apr. 15; *Ibid.,* 605 (1961) Apr. 29.

Carbureted water gas and oil gas plants are the most common types of cyclic gas making plants used in Great Britain. There are four necessary requirements for safe and efficient production of gas in these plants: 1) technical control; 2) means of adjusting the flow rates of air, steam and fuel; 3) automatic operation; and 4) routine plant operation by workers, who also raise and shut down, by putting the automatic operator in the hand position.

Economics and Efficiencies Realized in Oil Gas Machines of Semet-Solvay Design Utilizing Heavy Oil. E. M. Gocze. Paper No. CEP-61-7. (New York: American Gas Association, May 1961; $0.25)

Improvements in design of oil gas machines are discussed including: oil dispersion pattern, hollow shell gasification with counterflow medium, elimination of flow eddies in the generator, and use of heavier, cheaper oil. Flow sheets and a summary of overall annual results are presented.

Ore Reduction

Double-Action Kiln Shrinks Route to Iron. *Chem. Week 88,* 87 (1961) Mar. 25 (4 pp.)

Engineers of Allis-Chalmers Manufacturing Co. (Milwaukee, Wis.) are evaluating data on a new, direct iron-ore reduction process that A-C will soon be offering to steelmakers. Its ACAR process brings to at least twelve the direct-reduction methods available in the United States. Article tabulates eleven processes currently available to manufacturers who want to go into iron and steel production. Table indicates licensor and commercial status, means of reduction, product, and characteristic features.

The Focus Sinter Plant. *Coke and Gas 23,* 150 (1961) Apr. (3 pp.)

New single strand continuous sinter plant at Workington Iron and Steel Company (Great Britain) was officially opened in December. Designed ultimately to produce 12,500 tons of self-fluxing sinter/week, it is now in full operation. The ore is mined and processed in Norway, and shipped in the form of a powdered concentrate containing 65 percent iron. It is intended to consume between 60-70 percent of these Norwegian concentrates in the raw materials supplied to the new sinter plant, equivalent to an annual intake of 400,000 tons.

Reformed Gas

High-Temperature Pyrolysis of *n*-Butane. S. Sandler and Y. H. Chung. *Ind. Eng. Chem. 53,* 391 (1961) May (4 pp.)

For the pyrolysis in a flow system at temperatures ranging from 650°-900°C, an apparent activation energy of 45,600 cal/mole and a frequency factor of 9.55 X 10^9 sec^{-1} are reported. Such values—when compared with static system measurements—are consistently obtained in high-temperature, low-residence-time studies in reactors with a variety of surfaces and area-to-volume ratios. The results indicate that a primary reaction involving the formation of ethylene and hydrogen becomes increasingly important at high temperatures.

Thermal Cracking

On-Line Computer Control of Thermal Cracking. S. M. Roberts and C. G. Laspe. *Ind. Eng. Chem. 53,* 343 (1961) May (6 pp.)

Development of conversion expressions for on-line computer control of a cracking reaction is discussed. Based on simulation of the tubular reactor, sufficient insight into the temperature, pressure and conversion profiles was obtained to describe conversion in terms of reactor outlet conditions. The conversion expressions may be used for on-line computer control and as predictors.

8. GAS DISTRIBUTION

Customer Service

Gas Service to Mobile Homes. R. F. Ogborn. Paper No. DMC-61-13. (New York: American Gas Association, May 1961; $0.25)

During the past few months, Southern California Gas Company (Los Angeles) has received a number of questionnaires relative to gas service for mobile homes from utilities throughout the country. Principal areas of interest, according to these questionnaires, are: 1) municipal, county and state codes that affect company's ability to serve these customers; 2) design criteria for the distribution system within the trailer park; 3) method of connecting the mobile home to the park distribution system; 4) appliance design and approval requirements; and 5) appliance service policy. Author discusses each of these points.

Distribution Systems

Distribution Work. 1—Company-Performed vs Contractor-Performed. 2—Equipment Ownership vs Equipment Leasing. *Gas Age 127,* 27 (1961) Apr. 27 (5 pp.)

Special survey is concerned mainly with two points: the general practice among gas distribution companies as to use of outside contractors vs company personnel in construction and maintenance work, during peak and off-peak periods, and the general practice in ownership and leasing of motor vehicles and construction machinery. Report details in tabular form the data received from 87 companies serving nearly 78 percent of the nation's meters. It also gives comments of a large number of the respondents on their particular practices.

Procedures for Gathering Load Data for Distribution Design. Part 1. S. I. Hyman. **Part 2.** F. L. Buck. **Part 3.** J. H. Kerstetter, Jr. **Part 4.** S. Rosen. **Part 5.** S. C. Ward. Paper No. DMC-61-24. (New York: American Gas Association, May 1961; $0.25)

Representatives of five utilities describe their respective company's method of collecting basic data for distribution system design.

Joints

Bonding Compression Pipe Couplings Through a Small Hole. P. Ganser. Paper No. DMC-61-20. (New York: American Gas Association, May 1961; $0.25)

In 1957, the Philadelphia Electric Company started an extensive corrosion control program for a number of their large transmission and distribution mains 12 to 20 inches in diameter. Many of these lines are over 25 years old and mechanically coupled with compression-type pipe fittings having lead or armored tipped gaskets. Efforts were directed toward the development of a tool that could be inserted into a small hole in the paving with which some sort of metallic attachment could be made to the main and to the coupling from above the ground. It was suggested to try to convert a stud welding gun. Techniques and laboratory tests are discussed.

Leakage

A New Approach to Pinpointing Gas Leaks with Sonics. J. M. Reid, D. P. Hogan and P. L. Michael. Paper No. DMC-61-22. (New York: American Gas Association, May 1961; $0.25)

Development of a highly improved method for pinpointing the location of leaks in buried gas mains is the object of a research program sponsored by the A.G.A.-PAR plan. New sonic techniques have been developed which should permit accurate and rapid pinpointing from the surface of the ground. Very promising results have been obtained in the work to date with experimental mains not under paving. Successful completion of the development program should minimize the need for bar holes, excavations, or other inconveniences of existing methods. A major advantage of the method is that underground seepage of gas to remote surface points does not result in misleading information. The principles of operation and the results of experimental tests are described in the paper, which also serves as a progress report.

Mains

Techniques of Gas Main Mapping. E. C. Schroeder and E. B. Wirth. Paper No. DMC-61-19. (New York: American Gas Association, May 1961; $0.25)

Paper answers six questions 1) Why do you need a map? 2) What are the preferred points common to every map systems? 3) Which type of map is best for your company? 4) What are the practical techniques of modern utility company mapping? 5) What are the advantages resulting from these techniques? 6) Do these techniques build a firm foundation for the "computer age?"

Metering

Accomplishments to Date with Meter Standardization. J. Webb. Paper No. DMC-61-18. (New York: American Gas Association, May 1961; $0.25)

After describing some of the "growing pains" to which meter standardization has been subjected, author discloses recent noticeable gains, both direct and indirect. These include acceptance of ASA 49 color paint (80 percent of the meters sold today are painted with this color), and availability of meters for each class designation as required in the specifications.

Care and Preservation of Orifice Meters and Telemetering Equipment. R. A. Hunter. *Gas Age 127*, 42 (1961) Apr. 27 (3 pp.)

As gas transmission and distribution facilities continue to expand throughout the United States, more meters and telemetering equipment are used to provide information on the condition of the distribution system. Author briefly reviews care, maintenance and operation of such equipment.

Periodic Meter Changing. Part 1. A. D. Petersen. *Gas 37*, 63 (1961) May (3 pp.)

First of a three-part series covers the development of a way to change domestic meters without interrupting service. The hot change device employed for this purpose was invented by the Southern Counties Gas Co. (Los Angeles) to eliminate "return calls" on the part of a serviceman. Device was evolved from a combination of three separate things: 1) an alternate source of gas; 2) a rubber bag that allowed making a connection to the houseline without interrupting service; and 3) a hollowed-out rubber expansion plug.

Preparations to Determine Feasibility of Selective Testing of Gas Meters. F. Peters. Paper No. DMC-61-5. (New York: American Gas Association, May 1961; $0.25)

The industry expends large sums of money each year for the testing and processing of meters which do not require it, while conversely insufficient amounts are being directed toward those units needing more frequent attention, says author. There are many methods by which the sampling can be accomplished, and most are based on a statistical approach. Thus, a program designed to produce adequate statistical information must be formulated and followed to determine the feasibility of a selective testing program. The factors to be considered are discussed.

The Economics of Outdoor Meter Installations. D. J. Heim. Paper No. DMC-61-16. (New York: American Gas Association, May 1961; $0.25)

Paper deals only with domestic outdoor metering, and does not attempt to evaluate the several methods of reading indoor meters from outside of the house. That some savings will result from outdoor metering is a certainty, and these can amount to $2.50/meter/year and more. Tending to offset these savings is a loss of registration that may or may not result in a loss of revenue. In southern climes, the loss of revenue is negligible, but it becomes increasingly more pronounced in colder areas with a long history of indoor metering. In any area, outdoor metering provides an alternate method of installing a service that can save considerable footage of service in specific instances.

Odorization

Bibliography on Odorization. L. M. Van Der Pyl. Paper No. CEP-61-1. (New York: American Gas Association, May 1961; $0.25)

Author lists eleven publications in the field of odorization for the period January 1959-January 1960, and gives a short resume of the contents of each.

By-Pass Absorption Odorizers. R. F. Nowlin. Paper No. CEP-61-5. (New York: American Gas Association, May 1961; $0.25)

Author's company (United Gas Corporation, Texas) has used bypass absorption odorizers for three decades. While some refinements and improvements have been made during this period, these odorizers remain simple in design, have no moving parts to wear out or break down, and are relatively inexpensive to install. With proper selection of a malodorant, these odorizers give satisfactory results with minimum care and attention except for seasonal adjustments of the small flow con-

trol valve on the inlet piping to the odorizer. Several hundred of these are in service for the company, odorizing monthly volumes of 100-200 MCF.

Listing of Commercially Available Odorant Injection Equipment and Deodorant and/or Masking Agents. A. L. Wallace. Paper No. CEP-61-4. (New York: American Gas Association, May 1961; $0.25)

The Subcommittee on Odorization of Gas with the sanction of the Chemical and Engineering Committee has compiled a list of commercially available odorant injection equipment and deodorant and/or masking agents available on the market today. This publication, the first of its type, is planned as a guide and is not intended to give complete information on the equipment or product.

Oil Foggers

Oil Foggers—New Developments. L. Albert. Paper No. CEP-61-12. (New York: American Gas Association, May 1961; $0.25)

Author gives brief description of both "cold" and "hot" foggers, and describes modifications of each type to meet the changing operating problems faced by the gas industry.

Pressure Regulation

Regulator Station Design for Large Customers. A. Fleming. *Instruments and Control Systems 34,* 671 (1961) Apr. (4 pp.)

Delivery of large volumes of gas (8 MMSCF/hr) from high-pressure lines to steam plants and other large customers imposes many problems for the gas engineer in the design of regulator stations. Article covers the design and selection of regulators from the standpoint of stability, speed of response, and vibration.

What's New in Distribution Regulators. W. J. Krupp. Paper No. DMC-61-8. (New York: American Gas Association, May 1961; $0.25)

In recent years, the regulator manufacturers have engineered and developed gas regulators which are somewhat different in construction and principle from the common diaphragm-type regulators, whether they be spring- or pilot-loaded. Two of these new regulators, the piston and expansible element type, are described in the paper, together with their application, advantages and disadvantages as experienced by the Michigan Consolidated Gas Company in Grand Rapids, Michigan.

Service Piping

Experimental Investigation of Flow Characteristics of Low Pressure Services. D. Menegakis and E. H. Luntey. Paper No. DMC-61-15. (New York: American Gas Association, May 1961; $0.25)

Necessity to conduct tests and re-evaluate the flow and pressure drop characteristics of low-pressure services originated from the increased service loading due to house heating development. The results of these tests indicate the assumption that a smaller size copper tube is equivalent to a larger size steel pipe is not correct, and that the flow in services is a function of the inside diameter rather than the surface smoothness of the pipe. Furthermore, the original "Spitzglass" equation has been shown to need an adjustment. New resistance constants have been calculated and tabulated.

9. GAS FUEL UTILIZATION AND APPLIANCES

Air Conditioning

Why Gas Engines Are "Naturals" for Air Conditioning. C. E. Hartwein. *Ind. Gas 39* (Amer.), 5 (1961) Apr. (3 pp.)

Demand for air conditioning plus the low cost of natural gas has set the stage for a fast-growing practice of powering air conditioning refrigerant compressors with natural gas engines. Natural gas engines are not new, but it is only recently that the development of higher speed machines has made the use of this type of drive practical for operating air conditioning equipment. These industrial-type engines are sturdy, powerful, with large bearing surfaces, a balanced crankshaft, and built of materials to give many years of useful life.

Air Pollution

Air Pollution Problems of the Foundry Industry. Informative Report No. 1. Committee T1-7. *J. Air Pollution Control Assoc. 11,* 157 (1961) Apr. (6 pp.); **Informative Report No. 2. Gary Iron Foundry Practice and Air Pollution.** *Ibid.,* 162 (4 pp.); **Informative Report No. 3. Air Pollution Problems of the Investment Casting Process.** *Ibid.,* 165 (2 pp.); **Informative Report No. 4. Instruments and Techniques for Measuring Foundry Air Pollution Emissions.** *Ibid.,* 166 (7 pp.)

Public believes that the foundry industry is a potential source of air pollution, but when it is compared to many other basic industries, one finds that the equipment needed to reduce pollution of the air by contaminants from the foundry is for the most part in common use. Collectors that reduce particle emissions from grinding, cleaning, material handling, shakeouts, etc., have been in use for years by most foundries. Committee recommends that foundrymen study and understand the effects that air pollution can cause on man, animals, vegetation and property, as well as on the surrounding areas.

Exhaust Composition in Relation to Fuel Composition. R. E. Neligan, P. P. Mader and L. A. Chambers. *J. Air Pollution Control Assoc. 11,* 178 (1961) Apr. (9 pp.)

Among the six fuels studied, it was found that the hydrocarbon composition of the integrated exhaust gases was in each case related to the composition of its parent fuel. The olefinic compounds are of major interest, as they have been pointed out to be one of the principal reactants in Los Angeles smog. In the more

typical marketed fuels, an increase in fuel olefins was reflected by an increase of unburned fuel olefins in the exhaust gases, while the nature and concentration of the cracked products remained essentially the same.

Report No. 33. Seventh Technical Progress Report. W. L. Faith and N. A. Renzetti. (San Marino, Calif.: Air Pollution Foundation, March 1961. 85 pp.)

This last technical report to be published by the Air Pollution Foundation (no final report will be prepared) covers: 1) projects supported by the Foundation during its final year of operation, 1960; 2) related work by other laboratories; and 3) the status of motor vehicle pollution control, particularly the status of the development of afterburners. Work reported is divided into three main categories: atmospheric photochemistry, motor vehicle emissions and instrumentation.

Burners

A Review and Comparative Evaluation of Methods of Computation for Ejector Gas Burners. K. A. Privalova. Theory and Practice of the Combustion of Gas, Leningrad, Gostopizdat, 1958, 185-201; *Ref. Zh. Mekh.* No. 9 1959, Rev. 9969. [From *Appl. Mech. Rev. 14,* 319 (1961) Apr.]

Paper starts with a review of works dealing with the calculations for jet apparatus and continues with a comparative evaluation of jet burners with a view to their classification by their optimum characteristics. As the result of analysis of the data obtained, it was established, with an accuracy of sufficient exactness for practical purposes, that the dimensions of the mixer of the burner can be determined by means of formulas based on the constancy of the quality of motion without taking into consideration the velocity of the air entering the mixing chamber. The calculations can be simplified by adopting for the constant of the burner a magnitude capable of being determined by experimental means.

Yu. F. Dityakin
Courtesy Referativnyi Zhurnal, USSR

Combustion

The Eighth Symposium (International) on Combustion. D. W. Gill. *BCURA Monthly Bull. 25,* 38 (1961) Feb.-Mar. (24 pp.)

Review summarizes some of the more important points from the papers presented at the Symposium, held last year. The main emphasis was on the various aspects of rocket propulsion. Review includes a full list of the papers, none of which have yet been published.

Flame Research

Discontinuity Properties of Laminar Flames. T. Maxworthy. *J. Phys. Fluids 4,* 558 (1961) May (7 pp.)

Experimental investigation has been conducted to test the basic hypotheses of published infinite and finite two-dimensional flame front theories, in which the flame is considered to be a surface of discontinuity, in properties, between reactant and product flow field. Results show deviations from the theoretical predictions, due to secondary effects not considered by the theories.

Methane-Oxygen Flame Structure. III. Characteristic Profiles and Matter and Energy Conservation in a One-Twentieth Atmosphere Flame. R. M. Fristrom, C. Grunfelder and S. Favin. *J. Phys. Chem. 65,* 587 (1961) Apr. (4 pp.)

Set of characteristic profiles is presented for an oxygen-diluted methane flame (premixed, flat and laminar) giving local temperature, aerodynamics and composition as functions of distance through the flame front. The description provided by these profiles is complete with the exception of the concentrations of the radical and atomic species which could not be determined by the techniques used. Their concentrations were assumed to be quantitatively negligible. The validity of a one-dimensional description for this flame was tested experimentally by checking the invariance of the measured profiles with a radial distance in the burner, and by analyzing the deduced fluxes for material and energy conservation at a number of stations through the flame front. Agreement was considered satisfactory for quantitative study.

Methane-Oxygen Flame Structure. IV. Chemical Kinetic Considerations. A. A. Westenberg and R. M. Fristrom. *J. Phys. Chem. 65,* 591 (1961) Apr. (11 pp.)

Experimental data on temperature, composition and aerodynamic profiles in the reaction zone of oxygen-diluted methane flames at pressures of 1/10 and 1/20 atm are discussed in terms of the chemical kinetics of the flame reactions. It is shown that the profiles of net reaction rates for the stable species as determined from the data are internally consistent, and that the data at the two pressures indicate the predominance of bimolecular processes. The results of an exhaustive study of the possible elementary reactions that might occur are given, and a reaction mechanism proposed which accounts most simply for the observations.

Industrial Heating

Aluminum Alloy Coils Annealed Automatically in Car-Type Radiant-Tube Furnace. *Ind. Heating 28,* 690 (1961) Apr. (4 pp.)

Discussion of two-zone, car-type furnace of radiant-tube, gas-fired recirculating type, being used to anneal 5005 aluminum alloy coil between final rolling operations or preparatory to fabrication of screening and framing products. Rated for 30,000 lb of aluminum coil per load, the furnace, which has several unusual design features, automatically heats and soaks the coils.

Continuous Spheroidizing of Cold-Heading Coil Stock. J. Tschopp. *Ind. Heating 28,* 672 (1961) Apr. (3 pp.)

Brief description is given of a modern continuous pusher-type furnace which is heated by suction-type radiant tubes and designed for flexible operation. It has six temperature control zones. Gas-tight in construction, this type of furnace can be used for various heat treatments, with or without protective or reactive atmospheres.

Conversion to Radiant Firing Ups Quality and Productivity. G. K. Goodwin. *Ind. Gas 39* (Amer.), 10 (1961) Apr. (2 pp.)

Prevention of scale on trowels is major gain, improving quality and production rate; pot life is increased 1600 percent, while fuel cost is reduced. Greater controllability is another important feature.

Gas-Fired Multi-Passage Kilns. K. Davis and L. Walker. **Part 1.** *Gas J. 306* (Gas in Ind. Sect.), 86 (1961) Apr. 5 (7 pp.); **Part 2.** *Ibid.*, 113 (1961) May 3 (3 pp.); **Multi-Passage Kilns Solve Ceramic Problem.** *Gas World 153* (Ind. and Comm. Gas Sect.), 62 (1961) Apr. 15 (5 pp.); **The Design and Operation of Multi-Passage Kilns—1.** *Ind. Gas 24* (British), 20 (1961) Apr. (6 pp.)

Requirements of the ceramic industry for town gas continue to rise annually, and, currently, the Stoke-on-Trent district of the West Midlands Gas Board (Great Britain) supplies more than 8 MMCF/year for the firing of ceramics and for ancillary processes. Of this figure, over 7 MMCF is used exclusively for firing processes. Purpose of paper is to present development and operational data for the gas-fired multipassage kiln. Increasing world demand for ceramic goods has necessitated the introduction of a simpler type of peak load firing unit.

Modern Resin "Kitchen" Ups Output, Cuts Costs. W. H. Lerstad. *Ind. Gas. 39* (Amer.), 10 (1961) May (3 pp.)

In June 1959, a modern, electronically controlled resin "kitchen"—employing advanced radiant heat processing methods which had been production tested vs conventional oil-fired methods—went into full-time operation at Sapolin Paints, Inc. (Brooklyn plant). Conversion from oil to gas radiant heat has increased production by 50 percent, and achieved a 50 percent savings in fuel. Additionally, the plant can produce all of the company's alkyds, formerly purchased elsewhere.

LPG

Quick Dose of Propane Saves IKI Farms $180 an Acre. *Butane-Propane News 23,* 77 (1961) May (2 pp.)

IKI farms, Mecca, Calif., growers of tomatoes, applied propane to eliminate sour clover. Until this year, this project involved hand-hoeing at a cost of $200-$280 an acre; propane, applied by means of a home-made rig, accomplished the job for $12.

Ovens

Gas Assures Quality and Uniformity of Modern Grinding Wheels. A. Q. Smith. *Ind. Gas 39* (Amer.), 3 (1961) Apr. (2 pp.)

Organic bonded wheels are fired in batch-type ovens where they are placed at room temperature. The heat is applied and oven temperature is manually regulated to increase the heat slowly at the rate of 15°F/hr until the maximum temperature of 350°F is reached. They then remain at this temperature for 12 hours to accomplish complete curing.

Space Heating

Low Temperature Radiation. T. S. Holden. *ASHRAE J. 3,* 51 (1961) Apr. (4 pp.)

Methods for calculating low-temperature radiation to building surfaces from the sky, the ground and from neighboring buildings are presented by the author. Emphasis is placed upon a method developed for the case of a building surface at any angle to the horizontal, with the ground at any slope. Heat flow to or from the interior of a building depends on the construction of the building, on the external air temperature and wind conditions, and on the net radiation exchange between the external surfaces of the building and its surroundings. The radiation exchange can be divided into two types-solar (short wavelength) radiation, and low temperature (long wavelength) radiation.

More Economical MTW Systems. H. M. Bird. *ASHRAE J. 3,* 60 (1961) Apr. (7 pp.)

Engineers active in the field of hydronics have been searching for ways to move large quantities of heat over great distances, economically and under good control for use. Medium temperature, forced circulation, hot water heating with primary-secondary pumping and terminal equipment calls for small water quantities or deep temperature drops.

Ventilation

The Removal of Combustion Products from Gas Appliances. V. Bianchi and C. Manzoni. *Rivista dei Combustibili 15,* 131 (1961) Feb. (21 pp. Italian text.)

Author first discusses basic principles of gas fuel combustion, with remarks on the air required for combustion, the production of fumes, and ambient air pollution. He then considers ventilation, pointing out the systems that can be used to provide efficient aeration of a given premise and, as a logical consequence, calls attention to the chief features of natural drafts. The latter part of the paper deals with practical points, illustrating the rules to be followed for connecting the various types of gas appliances to chimney flues in the most efficient manner.

Water Heaters

Water Heater with Side Wall Venting Means. A. B. McCorquodale. U. S. 2,974,650 (1961) Mar. 14.

Invention pertains to gas water heaters for auto trailers; improvement claimed is concerned with the flue gas vent through the trailer wall. The jacket surrounding the combustion space is opened at the top by a horizontal vent, which passes into an outer chamber where vertical baffles divert the flow transversely. Space separators protect it from rain or vertical air drafts.

10. EQUIPMENT AND INSTRUMENTATION

Computers

Hydraulic Logic: What's Its Potential? H. H. Glaettli. *Control Eng. 8,* 83 (1961) May (4 pp.)

Signal-level hydraulic switching devices offer a new tool from which to build logic networks. Speed is about the same as that of conventional relays, while a simple valve's logic power lies midway between that of transistors and relays. Although hydrodynamic and inertial effects cause problems, practical devices have been built and more are proposed. Moreover, future looks bright since the use of plastic molding techniques to form multi-element units promises lower production costs and higher switching speeds.

Fluid Flow

Capillary Flowmetering. L. M. Polentz. *Instruments and Control Systems 34,* 648 (1961) Apr. (3 pp.)

Small fluid (liquid or gas) flow rates can be measured by a direct-reading flowmeter based on the Poiseuille-Hagen principle of viscous drag through small-diameter tubes at low Reynolds numbers. Such a meter can be constructed from a short length of commercially available tubing sized so that the flow will be well within the viscous region. The head loss then will be directly proportional to the rate of flow, and thus the rate of flow can be read directly on a manometer which measures the loss of head through the tube.

Coefficient of a Pitot-Tube Flow Detector. J. M. Robertson and F. E. Shuster. *Instruments and Control Systems 34,* 645 (1961) Apr. (3 pp.)

Pitot tube in the flow detector described is simply a hole in a cylinder (tubing) which spans the pipe. This piezometer hole looks upstream to sense impact pressure. The pipe contains wall (piezometer) holes for static pressure. The only important source of error results from the blocking effect of the small transverse cylinder on the wall piezometers. For normal turbulent flow, the pitot coefficient is given by a simple equation involving the ratio of the cylinder-to-pipe diameters.

How to Select a Flowmeter. C. C. Miesse and O. E. Curth. *Product Eng. 32,* 35 (1961) May 8 (12 pp.)

Comprehensive article not only lists the commercially available flowmeters, plus distinctive special types, but it also shows how two steps will simplify the selection procedure.

The Boundary-Layer Mass Flowmeter. J. H. Laub. *Instruments and Control Systems 34,* 642 (1961) Apr. (3 pp.)

Mass flow of gases and liquids can be measured accurately by determining the rate of heat transfer through the boundary layer of the fluid. In recent years, mass flowmeters have been developed using mechanical measuring elements inserted into the stream, which are exposed to attack and contamination by the fluid. The flowmeter has a smooth bore and negligible pressure drop, and measuring elements do not contact the fluid.

The D-P Flowmeter Equation. P. Odom. *Instruments and Control Systems 34,* 634 (1961) Apr. (4 pp.)

Article comprises the derivation of the basic constant-area differential-pressure flowmeter equation for venturis, nozzles, orifices, and dall flow tubes.

Gas Turbines

A Gas Turbine "CO" Boiler Installation; Economic and Themodynamic Analysis. C. Bultzo. *Combustion 32,* 22 (1961) Apr. (5 pp.)

Author presents a detailed thermodynamic analysis of a combined gas turbine CO boiler installation. Regenerator flue gas with 9 percent CO is burned to CO_2 using gas turbine exhaust gas which contains 17 percent O_2. In addition, the first costs of a steam turbine drive are compared to those of the gas turbine installation. The summary is a comparison of the anticipated efficiency with those being experienced.

How to Overhaul a Gas Turbine. R. Burke. *Pipeline Eng. 33,* D-23 (1961) May (3 pp.)

Overhauling a gas turbine as practiced by El Paso Natural Gas Company is a systematic procedure, planned to keep the turbine in service on the line as long as possible but to prolong its working life by scheduling periodic maintenance. Scheduling the overhaul and steps in the maintenance procedure are briefly described.

Instruments

Fundamentals of Frequency Response. G. Blunck. *Gas Age 127,* 33 (1961) Apr. 27 (6 pp.)

Use of frequency response information has become established as a practical and satisfactory approach for stability analysis and prediction of control systems and component performance. Author's objective is to provide those concerned with controls with a basic understanding of this technique and an acquaintance with the terminology.

Steam Generation

VDI-Steam Tables, Including a Mollier (i,s) Diagram for Temperatures up to 800°C. E. Schmidt. (Berlin: Springer-Verlag, 1960; 119 pp., in German, French and English; 5th revised ed. DM 15.) [From *Appl. Mech. Rev. 14,* 310 (1961) Apr. (2 pp.)]

These tables of volume, enthalpy, and entropy are in three parts. The first involves the properties of a saturated liquid and gas with temperature as the independent variable. The second also relates to saturated liquid and gas with pressure as the independent variable, while the third is concerned with properties in single-phase regions. The temperatures are in degrees Centigrade, the pressures in atmospheres, and the other properties in the usual metric units based upon the absolute Joule. Single-phase data extend to temperatures of 800°C and to

pressures of 500 atmospheres. A Mollier diagram is included.

B. H. Sage, USA

Temperature Measurement

Calibration of Platinum Resistance Thermometers. *Nat. Bur. Standards Tech. News Bull. 45,* 62 (1961) Apr. (4 pp.)

Growing need is evident in all branches of science and technology for temperature measurements of increased accuracy and precision. This is true not only over the usual range of temperatures, but in the more extreme temperature regions as well. Platinum resistance thermometers, which can be used over a wide range of temperatures with great effectiveness, help to fill this need. The Bureau of Standards, through its calibration services, contributes to the accuracy and uniformity of temperature determinations made with these instruments.

Ceramic-Insulated Thermocouples. L. Scadron. *Instruments and Control Systems 34,* 856 (1961) May (2 pp.)

New advances in manufacturing techniques have made it possible to manufacture ceramic-insulated metal-sheathed wires using large-diameter initial tubing that will produce long lengths to close electrical and physical tolerances without splices. Special assemblies, such as triaxial and bitriaxial thermocouples are now possible and practical. Using the old techniques, they are not. Voids in the insulation are non-existent in multiple-pass drawn material.

Temperature Measurement by Filled System. R. C. Nelson. *Instruments and Control Systems 34,* 849 (1961) May (6 pp.)

Scientific Apparatus Manufacturer's Association has classified filled-system thermometers into four major categories according to filling material. Class I is completely filled with liquid (other than a metal, such as mercury) and operates on the principle of liquid expansion. Class II is a system partially filled with a volatile liquid and operates on the principle of vapor pressure. Class III is filled with a gas and operates on the principle of gas pressure change with temperature change. Class V is filled with mercury or mercury-thallium eutectic amalgam and operates on the principle of liquid expansion. Applications for each class are discussed.

Liquid-in-Glass Thermometers. J. F. Swindells. *Instruments and Control Systems 34,* 846 (1961) May (3 pp.)

Liquid-in-glass thermometer is probably the most widely used temperature measuring device in both science and industry. It is singularly attractive where reliable temperature measurements are required but the highest attainable accuracy is not necessary. If the user is to recognize its inherent limitations, he must have, in addition to its calibration, some knowledge of the behavior to be expected of such a thermometer, the important features of good practice in the design and use of liquid-in-glass thermometers, and the techniques used by the National Bureau of Standards in their calibration.

Valves

Control Valves. First Cost vs Operating Cost. W. J. Schmidt. *Control Eng. 8,* 109 (1961) May (4 pp.)

Pumping a fluid through a valve costs money. Present methods of valve sizing do not take this into account. Hence, the author argues that control valve sizing should be based on smallest annual operating cost, not smallest first cost, provided of course that the selected valve gives good control. A numerical example comparing the economic and conventional methods of valve sizing is given.

11. MATERIALS OF CONSTRUCTION AND CORROSION

Alloys

High Temperature Sulfur Corrosion of Intermediate Range Chromium Steels. R. E. Hannum. *Corrosion 17,* 201t (1961) May (2 pp.)

Laboratory tests were conducted to find a suitable replacement material for 5 percent chromium—½ percent molybdenum tubes used in a thermal desulfurization unit. The steel found most suitable for this use had a 9 percent chromium content. Maximum corrosion loss in wall thickness of this material was less than 0.030 inch, with a total expected life of at least 5 years. The sulfur content of various crudes commonly used in furnaces is reported.

Welded Stainless Steels for Hot Hydrogen Sulfide Service. F. J. Bruns. *Corrosion 17,* 227t (1961) May (5 pp.)

Description is given of the effects of welding, heat treatment and composition on corrosion rates of various grades of stainless steel exposed to 615°F hydrogen-hydrogen-sulfide stream in a commercial desulfurizer. The study was conducted by weight loss measurements and metallographic examinations. It was found that in the thermally stabilized condition, the manganese substituted stainless steels showed slightly better resistance to high-temperature hydrogen sulfide than the conventional nickel stainless steels. It was also found that a thermal stabilizing treatment at 1630°F increased the corrosion rate of all the austenitic stainless steels tests in hot hydrogen sulfide.

Carbon

Carbon Engineering Components for Corrosive Conditions. R. K. Hurden and W. A. Llewellyn. *Corrosion Tech. 8,* 103 (1961) Apr. (5 pp.)

Use of carbon or graphite components is now well established in a wide variety of applications where chemical corrosion or the need for lubrication precludes the use of more conventional engineering materials. Some of these applications, with particular reference to operation in chemical or corrosive conditions, and the properties and limitations of the carbon materials are discussed.

Cathodic Protection

Cathodic Polarization of Steel in Salt Water. A. R. Erben. *Corrosion 17,* 222t (1961) May (5 pp.)

Laboratory study was conducted of the effect on several variables on the cathodic polarization of steel. For several phases of testing, actual produced fluid from West Texas oilfields was used. Laboratory work included studies involving temperature changes, the effect of two corrosive acid gases, the effect of varying amounts of an organic acid, and the comparison of actual produced fluids with synthetic fluids. It was found that changes in temperature from 78° to 150°F had a decided depolarizing effect on steel in salt water. Mineral constituents of the fluids handled dictated the amount of current needed for the cathodic polarization of steel. The addition of carbon dioxide and hydrogen definitely depolarized steel in a salt water system.

Interference with Railroad Signal Systems from Cathodic Protection Currents. F. L. Chatten. Paper No. DMC-61-3. (New York: American Gas Association, May 1961; $0.25)

Relationship and importance of track circuits to railroad signal systems, and their construction and basic requirements to conform to Interstate Commerce Commission rules are reviewed. The need for freedom from outside influences is explained. Testing procedures to detect interference currents in track circuits and corrective measures are covered. Known cases of past interference are reviewed.

Coatings

Factors Affecting Adherometer Adhesion. The Work of Removal of Organic Coating. L. R. Brantly. *J. Chem. and Eng. Data 6,* 288 (1961) Apr. (2 pp.); **Removal of Organic Coatings.** *Ind. Eng. Chem. 53,* 310 (1961) Apr.

Evaluation of adhesion of an organic coating requires consideration of three regions in which failure in adhesion may occur: the substrate, the interphase and the coating. Surface preparation of metallic substrates for industrial finishes has been improved to the extent that the failure in adhesion of an organic coating to a metallic surface in the testing process should take place not in the substrate but in the interphase or region of transition between the metallic substrate and the body of the organic coating.

Effect of Some Application Variables on Maintenance Coating Performance. J. R. Allen, F. W. Thompson and M. L. Monack. *Corrosion 17,* 22 (1961) May (3 pp.)

Because data indicate that good practices adopted and reported in a 1956 report to the NACE have been successful in reducing protective coatings costs to a plateau, the authors investigated application variables to produce further improvements. Equipment designed permitted controlled spraying of various coatings at fixed spray-to-work distances so this factor, the one least amenable to control, could be evaluated. Results are discussed.

Epoxies Give Good Service in Well Casing Coating Test. W. R. Lambert. *Corrosion 17,* 14 (1961) May.

Brief description is given of coatings tested on well casing exposed for 18 months in West Virginia. It is concluded that epoxies gave the best service. Tubular data give coatings tested and well log on test well.

Joint Coatings for Mill Coated Pipe. C. W. Beggs. Paper No. DMC-61-1. (New York: American Gas Association, May 1961; $0.25)

Reason for a field joint in a precoated pipe is discussed. Seven methods of making such joints are listed. Warnings are given about undesirable coating characteristics. The special requirement of a new type coating is given.

Special Coupon Shapes Used in Testing Liner Coatings. O. W. Siebert. *Corrosion 17,* 16 (1961) May (3 pp.)

Because the coupons employed for atmospheric tests of coatings do not give reliable information when used for testing coating for liners, advantages of several special configurations were explored. These included spheres, various configurations of the torus and the Moebius shape. Author concludes that the latter configuration apparently gives the most reliable information. Experiments are being continued to establish whether or not one configuration is better than another.

Susceptibility of Epoxy Coatings to Damage by Fresh Water Immersion. H. Moroson. *Corrosion 17,* 28 (1961) May (2 pp.)

Data are given on tests of epoxy coatings' resistance to submersion in fresh water with a variety of curing agents as the variable. Examples are given showing where formulations cured by amines failed. Naval Research Laboratory tests showed epoxy coatings blistered consistently. A hypothesis is offered on the mechanism by which the coatings fail and on the mechanism of blistering.

Corrosion

First International Congress on Metallic Corrosion, London, 1961. *Corrosion Tech. 8,* 109 (1961) Apr. (13 pp.)

Article presents summaries and abstracts of some of the 80 papers presented at the week-long congress.

Corrosion of Aluminum Alloys in High Purity Water in the Range 150°C–340°C. D. F. MacLennan. *Corrosion 17,* 239t (1961) May (4 pp.)

Examination of the cross section of the film on aluminum and its alloys, while attached to the metal, reveals that the second phase particles play an important part in the corrosion pattern. The 2S aluminum contains at least two types of second phase particles, one of which corrodes more rapidly while the other corrodes more slowly than the surrounding aluminum. The majority of second phase particles in the 157 alloy corrode more slowly than the surrounding aluminum.

Electrolysis Drainage Switches. W. T. Luttrell. Paper No. DMC-61-10. (New York: American Gas Association, May 1961; $0.25)

Drainage switch is part of the electrolysis bond between the structure to be protected and the source of stray currents, the substation. Protection is afforded the underground structure by draining the stray current from the structure to the substation. In a pipeline, this requires that its potential be higher than that of the station. Paper is limited to the different types of switches, their operations and limitations.

Isolation of Services—The Key to Successful Corrosion Control. T. Snedden. Paper No. DMC-61-12. (New York: American Gas Association, May 1961; $0.25)

Author describes his company's experiences with a device developed to test insulating unions. The tester uses the principle of induction of an impressed a.c. along a conductor. With this device, an insulating coupling can be checked in place, without calculations. It is simple to operate, requires little or no maintenance and is light in weight.

Potential Survey to Determine the Condition of a Gas Distribution System. R. H. Saunders. Paper No. DMC-61-9. (New York: American Gas Association, May 1961; $0.25)

Use of a pipe-to-soil potential survey to determine anodic and cathodic areas on a pipeline has been used for several years. Generally, such surveys have been conducted on comparatively long distribution or transmission lines. Author's company (Rochester Gas and Electric Corp., Rochester, N.Y.) has adapted this procedure for use on nearly all the bare steel pipe in their distribution system. The need for accurate evaluation of the condition of the pipe in a distribution system is important for safety and economic reasons. Company believes that procedure they use, and which is described, assists in this evaluation.

Soil Bacteria and Corrosion. J. O. Harris. Paper No. DMC-61-21. (New York: American Gas Association, May 1961; $0.25)

Author recently returned from a six months' tour of the United States during which he gathered background information, conducted field studies, and performed research in laboratories actively engaged in the study of hydrocarbon utilization by microorganisms. At least five major conclusions are apparent from the data gained from field investigations: 1) high populations of bacteria exist near the organic coating and/or wrapping systems of underground pipelines; 2) the bottom of the pipeline ditch contains more water than other locations in the immediate area; 3) aerobic conditions are common in the soil at pipeline depths; 4) hydrocarbon-oxidizing bacteria are widely distributed in the soil; and 5) both sulfate-reducing bacteria and hydrocarbon-oxidizing bacteria are often present in the water under unbonded coating systems. Paper discusses these findings as they relate to microorganisms and environmental conditions of soil in the back-filled pipeline ditch.

Inhibitors

Development of a Mineral Scale Inhibitor. L. W. Jones. *Corrosion 17,* 232t (1961) May (5 pp.)

Expense attributable to scaling in oil-producing operations totals many millions of dollars annually. Causes of precipitation and deposition are fairly well undertood but better methods of control are needed, says author. In order to evaluate chemical scale inhibitor components, a laboratory testing device was designed. Performance of sequestrants, surface active agents, colloids, and mixed compounds in the laboratory tester are discussed. Results of tests conducted over a period of several years led to the development of an inhibitor composition that is capable of inhibiting both carbonate and sulfate scales. The inhibitor is now in field use.

Effect of Acid Volume and Inhibitor Quantity on Corrosion of Steel Oil Field Tubing in Hydrochloric Acid. W. E. Billings and D. Morris. *Corrosion 17,* 208t (1961) May (7 pp.)

Several different types of corrosion on downhole tubing in the presence of hydrochloric acid are discussed. It is shown that ordinary acid attack in most instances is not sufficient to cause failure. Corrosion rates of J-55 oilfield tubing were determined at several different temperatures with inhibited 15 percent hydrochloric acid. Ethoxylated rosin amine, dibutylthiourea, hexynol, and an arsenic containing compound were used as inhibitors. The effect of different acid volume to coupon surface area relationships on corrosion rate with the preceding inhibitors is shown. Also included is a nomograph for corrosion rate calculations.

Insulation

How Much Insulation for Pipes and Flat Surfaces? C. A. Arents and H. M. Cather. *Air Conditioning, Heating and Ventilating 58,* 65 (1961) May (16 pp.)

Practical means for specifying the exact thickness of thermal insulation for maximum economy was developed at the College of Engineering, West Virginia University, in cooperation with and under the sponsorship of Union Carbide Chemicals Company. The procedure is embodied in a "Manual on Economic Thickness of Insulation for Flat Surfaces and Pipes," to be issued by the National Insulation Manufacturers Association. By referring to charts, an engineer can find the solution to any of billions of possible combinations of variables, including cost of heat energy, insulation, capital at various periods of amortization, and conductivities of insulations at different temperatures.

Sulfur

Purification and Properties of Sulfurylase from Desulfovibrio desulfuricans. B. S. Baliga, H. G. Vartak and V. Jagannathan. *J. Sci. & Ind. Research 20C,* 33 (1961) Feb. (8 pp.)

Sulfurylase from the sulfate-reducing bacteria *Disulfovibrio desulfuricans* has been purified and its properties studied. A sulfite-activated adenosine triphosphatase and a cobalt-activated pyrophosphatase are shown to be present in the insoluble fraction of the bacterial cells.

12. ANALYTICAL METHODS AND TESTS

Air Pollutants

Air Pollution. J. P. Lodge, Jr. *Anal. Chem. 33,* (Analytical Reviews issue) 3R (1961) Apr. (11 pp.)

Air pollution review covers the period 1959-60, and supplements the previous review with the exception that the growth of the literature has been so great that explicit coverage of radioactive pollutants has been omitted. The trend toward increased interest in automotive exhaust and atmospheric carcinogens, noted in the previous review, has continued. In addition, there has been a renewal of interest in atmospheric lead. For the most part, these observations hold only for the United States. The bulk of research in Europe continues to be directed toward improved methods for measurement and control of sulfur dioxide and dust. Bibliography contains 390 references.

Analytical Methods

How to Evaluate Accuracy. W. J. Youden. *Materials Res. & Standards 1,* 268 (1961) Apr. (4 pp.)

Article presents a logical breakdown of the error in measurement into 1) the systematic error inherent in the procedure; 2) the local systematic error of the laboratory using the procedure; and 3) the random error (precision). Several methods are given for identifying sources of error in measurements.

How to Evaluate Precision. W. S. Connor. *Materials Res. & Standards 1,* 272 (1961) Apr.

Article covers one aspect of how to evaluate the precision of a test method by comparing the results from several laboratories. A common procedure for carrying out such a comparison is to distribute some specimens of experimental material to each laboratory and to have these facilities test the specimens according to the prescribed method. Then the results of the laboratories are compared. The variation among the average results for the laboratories is a measure of the precision of the test method when carried out by different laboratories.

On the Analysis of Planned Experiments. M. E. Terry. *Materials Res. & Standards 1,* 273 (1961) Apr. (3 pp.)

Over the past three decades, two theoretical approaches to the statistical treatment of research and development problems have evolved. Paper proposes to show how both can be used together in the analysis of data.

On the Meaning of Precision and Accuracy. R. B. Murphy. *Materials Res. & Standards 1,* 264 (1961) Apr. (4 pp.)

Author presents a semantic argument on the meaning of accuracy. For some years, the terms precision and accuracy have been used in connection with problems of measurement. About ten years ago ASTM Committee E-11 on Quality Control of Materials set itself the task of setting down some definitions of these two ideas. The question author tries to settle is which of two particular meanings the word "accuracy" should have.

Calorific Value

Proposed Standard Method for Calculating Heating Value and Specific Gravity from Gas Composition. D. McA. Mason and B. E. Eakin. Paper No. CEP-61-11. (New York: American Gas Association, May 1961; $0.25)

New method of calculating the heating value and specific gravity of fuel gases from the composition of the gas has been developed. The ideal gas heating value and ideal gas specific gravity are calculated, then corrected to the real gas basis by means of a calculated compressibility factor. Method is applicable to all common types of utility fuel gases, including dry natural gas, reformed gases, oil gas (both high- and low-Btu), propane-air, carbureted water gas, coke oven and retort coal gas. When the gas contains less than 1 percent of C_5 olefins, C_6 paraffins, and C_8 aromatics, and less than 0.05 percent of C_7+ paraffins, C_6+ olefins, and C_9 aromatics, the error in the calculated heating value is less than 0.05 percent. This error is due to uncertainties in the calculated compressibility factor of the mixture and reported heating values of the pure components and does not include error due to inaccuracy of the analysis.

Chromatography

Gas-Liquid Chromatography of Basic Nitrogen Compounds. A. W. Decora and G. U. Dinneen. *U. S. Bur. Mines Rep. Invest. 5768.* (Washington, D. C.: U. S. Govt. Print. Off., 1961.)

Gas-liquid chromatography has been applied to the separation of basic nitrogen compounds, such as pyridines and amines. Close-boiling compounds have been separated by exploiting structural and polarity differences, using selective liquid substrates dispersed on specially prepared solid supports. Development of these special supports was necessary in order to obtain symmetric peaks for basic nitrogen compounds; solution of this problem was important in applying gas-liquid chromatography to the analysis of basic nitrogen compounds found in shale oil.

Identification of Components in Paraffin Wax by High Temperature Gas Chromatography and Mass Spectrometry. E. J. Levy, R. R. Doyle, R. A. Brown and F. W. Melpolder. *Anal. Chem. 33,* 698 (1961) May (7 pp.)

High-temperature gas chromatography is combined with mass spectrometry for the identification of 67 compounds in paraffin wax. Two columns were employed, operating at 300°C. Compounds identified are *n*-paraffins, 1-cyclopentyls, 1-cyclohexyl, 2- to 5-methyls, 1-phenyls, and mono- and dimethyl compounds.

Identification of Hydrocarbon Peaks in Gas Chromatography by Sequential Application of Class Reactions. R. Rowan, Jr. *Anal. Chem. 33,* 658 (1961) May (8 pp.)

Method depends upon the use of two series of class reactions in different sequence. Reactions employed include absorption of olefins or olefins plus aromatics, hydrogenation of olefins, dehydrogenation of naphthenes, and absorption of straight-chain compounds. These operations are carried out rapidly and conveniently in a closed system which is an integral part of the gas chromatographic apparatus. The method has been demonstrated on a synthetic sample and a commercial gasoline. All peaks were identified by hydrocarbon class and over half by name. In many cases, hidden peaks were revealed.

Fuels

Solid and Gaseous Fuels. W. H. Ode and T. Christos. *Anal. Chem. 33,* (Analytical Reviews issue) 61R (1961) Apr. (9 pp.)

Article is the seventh of a series of reviews on methods of sampling, analyzing, and testing solid and gaseous fuels. It covers a 2-year period ending September 1960. Inorganic constituents of ash and revision of methods for national and international standards are reviewed. In gas analysis, considerable activity in chemical methods is reviewed. Bibliography cites 176 references.

Mass Spectrometry

Mass Spectra of Aliphatic Thiols and Sulfides. E. J. Levy and W. A. Stahl. *Anal. Chem. 33,* 707 (1961) May (16 pp.)

Mass spectra data are used for molecular structure correlation rules related to sulfur-containing compounds or off-odor components of irradiated beef. The correlations enable a compound to be identified as a thiol or sulfide and then assigned to a structure class within each sulfur compound type.

Moisture

High-Speed Moisture Measure — Tool for Lab and Line. R. R. Moore. *Research/Development 12,* 13 (1961) Apr. (8 pp.)

Basically, modern moisture counters measure moisture content either 1) by measuring some physical characteristic or 2) by measuring some electrical characteristic of a material. Four types of instruments are available today: chemical, relative humidity, weight change, and electronic. Features and applications of each type are discussed.

Petroleum

Petroleum. R. L. LeTourneau. *Anal. Chem. 33,* (Analytical Reviews issue) 92R (1961) Apr. (21 pp.)

Article is a comprehensive and selective review of the literature on the composition, analysis, and testing of petroleum which has appeared since the previous review (1959) until about October 1, 1960. Author has compiled a bibliography of 806 references.

Spectrophotometry

A New Spectrophotometric Method for the Determination of Acrolein in Combustion Gases and in the Atmosphere. I. R. Cohen and A. P. Altshuller. *Anal. Chem. 33,* 726 (1961) May (8 pp.)

Spectrophotometric method is devised for the determination of acrolein in combustion gases and the atmosphere. Acrolein reacts with 4-hexylresorcinol under proper conditions to give a blue color with an absorption maximum at 605 mμ. Hydrocarbons, olefins, phenols and other compounds tested do not interfere.

Determination of Nonaromatic Unsaturates in Automobile Exhaust by Spectrophotometric Titration. P. P. Mader, K. Schoenemann and M. Eye. *Anal. Chem. 33,* 733 (1961) May (4 pp.)

High molar absorptivity of free tribromide ion in the ultraviolet provides a basis for determination of C_4 and higher molecular weight olefins in automobile exhausts and other gas mixtures. Consistent and reproducible results are obtained for concentrations between 25 and 1000 ppm. Ethylene and propylene interference is minimized.

Sulfur

Transwestern Makes on-the-Spot Sulfur Analysis. W. A. Garratt. *Pipeline Eng. 33,* D-20 (1961) May (3 pp.)

Equipment used by Transwestern to determine sulfur concentrations is a portable fast-acting analyzer which is a manually-operated potentiometric electrolytic titrator. It can be used to determine concentrations of hydrogen sulfide, mercaptans, sulfides, and residual sulfur to the nearest 0.001 grain/100 CF in less than 30 minutes. The portability features of the instrument lends itself to the conductance of routine wellhead tests and periodic tests at pipeline locations without provisions for sample containers.

13. BASIC SCIENCE

Adsorption

Thermodynamics of Interlamellar Complexes. R. M. Barrer and K. E. Kelsey. *Trans. Faraday Soc. 57,* 452 (1961) Mar. (11 pp.)

Monomethylammonium and tetramethylammonium montmorillonites have been used as sorbents in an investigation of heats and entropies of intercalation and adsorption of n- and iso-butane, n-heptane, isoheptane, iso-octane, cyclohexane and benzene. Intercalation was a much more strongly exo-energetic process than adsorption upon external crystallite surfaces, and involved much larger decreases in entropy. The variation of differential heats and entropies of sorption with amount sorbed has been determined for the above hydracarbon + alkylammonium montmorillonite systems, and has been interpreted where possible. The occurrence of hysteresis loops in the sorption isotherms introduces

some uncertainty into the thermodynamic interpretation of sorption equilibria, but is not believed to prevent a qualitative understanding of the observed behavior.

Ammonia

Ammonia Vapor Pressure of Ammoniacal Solutions of Ammonium and Copper (II) Sulfates. R. L. Benoit. *J. Chem. and Eng. Data 6,* 161 (1961) Apr. (6 pp.)

In view of the absence of quantitative data on ammoniacal solutions of ammonium and copper (II) sulfates and of the current interest in the treatment of metal-amine sulfates solutions, it was believed worthwhile to determine the ammonia vapor pressure of such a system over a range of temperatures and to correlate the results with solution composition. Some aspects of the distillation of metal-amine solutions are discussed.

Ultra-Violet Absorption Spectrum of Ammonia. A. D. Walsh and P. A. Warsop. *Trans. Faraday Soc. 57,* 345 (1961) Mar. (15 pp.)

New data on the ultra-violet absorption spectrum of ammonia and deuterated ammonias are reported and used, together with older data, in an interpretation of the spectrum. Five electronic transitions are particularly studied. Each is represented by a long progression of bands. The origins of four of the transitions lie at 2168A, 1665A, 1434A and 1330A; the fifth is of unknown origin but is responsible for bands in the neighborhood of 1268A.

Viscosity and Thermal Conductivity of Ammonia in the Gaseous and Liquid States. W. S. Groenier and G. Thodos. *J. Chem. and Eng. Data 6,* 240 (1961) Apr. (5 pp.)

Most studies concerned with the transport properties of pure substances have been largely restricted to those of a nonpolar nature. Generalized correlations have been developed that enable the prediction of viscosities and thermal conductivities from a knowledge of the critical properties of the substance. Ammonia has been arbitrarily selected for study, since this substance not only possesses a relatively low critical compressibility factor, but also a significant dipole moment.

Detonation

Detonation Properties of Heavy Knallgas, 2 D_2 + O_2. L. B. Adler, J. A. Luker and E. A. Ryan. *J. Chem. and Eng. Data 6,* 256 (1961) Apr. (5 pp.)

Study reported considers both the stable detonation velocity and reflected, or "impact," detonation pressure in testing the experimental and theoretical detonation agreement of heavy knallgas. Conditions covered are 1-15 atm initial pressure at 25°C. Since adequate comparison is necessary to the analysis, corresponding properties of knallgas have also been determined.

Diffusion

Diffusion Coefficients of Ethane in the Liquid Phase of the Ethane—White Oil System. H. H. Reamer and B. H. Sage. *J. Chem. and Eng. Data 6,* 180 (1961) Apr. (5 pp.)

Investigation of the molecular transport of the lighter paraffins in the liquid phase of hydrocarbon mixtures was initiated by Lacey, with primary emphasis upon the transport of methane. As a result of the marked variation in the Fick diffusion coefficient for methane with the nature of less volatile component in binary systems, the molecular transport of ethane in the liquid phase of the ethane—white oil system was studied at pressures up to 1000 psi in the temperature interval between 40° and 400°F.

Fluid Flow

Effect of Roughness on Transition in Supersonic Flow. E. R. Van Driest and C. B. Blumer. AFOSR TN 60-1164 (North American Aviation, Inc., Aero-Space Lab., MD 60-329), 36 pp., Mar. 1960. [From *Appl. Mech. Rev. 14,* 301 (1961) Apr.]

Further experiments carried out in the 12-inch supersonic wind tunnel of the Jet Propulsion Laboratory of the California Institute of Technology to investigate the effect of three-dimensional roughness elements (spheres) on boundary-layer transition on a 10-degree (apex angle) cone without heat transfer are reported. The local Mach number for these tests was 2.71. Data show clearly that the minimum (effective) size of trip required to bring transition to its lowest Reynolds number varies as the one-fourth power of the distance from the apex of the cone to the trip.

From authors' summary

Flow of Fluids. M. Weintraub. *Ind. Eng. Chem. 53,* 405 (1961) May (4 pp.)

In his review, author finds that new fields of chemical processing are benefiting from flow analysis; influence of roughness on laminar-turbulent transition is being studied; empirical knowledge of solid-fluid transport continues to increase. He discusses single-phase flow; metering and controls, multiphase flow, and piping and pumps.

The Critical and Two Phase Flow of Steam. W. G. Steltz. *J. Eng. Power 83A,* 145 (1961) Apr. (10 pp.)

Article is concerned with the one-dimensional, isentropic flow of a compressible fluid at the point of minimum area in a converging or a converging-diverging passage.

Transient Two-Phase Capillary Flow in Porous Media. D. E. Elrick. *J. Phys. Fluids 4,* 572 (1961) May (4 pp.)

Dynamics of two-phase capillary displacement in a finite one-dimensional system following a step change in pressure of one phase at one end is considered. Darcy's law and the equation of continuity for each phase together with the capillary pressure—saturation relation are the fundamental equations describing the flow system. The resulting system of differential equations is linearized by assuming a linear relationship between the capillary pressure and the saturation as well as constant conductivity values of both phases (these assumptions are valid for small step changes in pressure). Solutions of the linearized problem are found and presented in some detail.

Use of the Roughness Criterion to Refute Roughness as the Cause of Reported Transition Reversal. J. M. Bidwell. *J. Aerospace Sci. 27,* 622 (1960) Aug. (2 pp.) [From *Appl. Mech. Rev. 14,* 301 (1961) Apr.]

Experiments have shown that transition Reynolds number at first increases and then rapidly decreases with increasing heat transfer rate to wall. Author calculates the critical surface roughness necessary to cause transition under conditions of heat transfer to wall, and concludes that this is much greater than the roughness present in the experiments. Thus a previous suggestion attributing the fall of transition Reynolds number to the increasing effects of surface roughness is refuted.

N. C. Lambourne, England

Heat Transfer

Heat Transfer and Pressure Drop in an Annular Gap with Surface Spoilers. G. A. Kemeny and J. A. Cyphers. *J. Heat Transfer 83,* 189 (1961) May (8 pp.)

Heat transfer and pressure drop data are presented for turbulent water flow in the annular space between concentric tubes. Heat was transferred to the liquid from the inner surface which was equipped with various surface spoiler configurations. A common outer tube was used which was maintained smooth and adiabatic for all tests. An empirical formula is given which correlates friction factors for circular tubes and annular gaps, or narrow flat passages, with semicircular spoilers on either one or both sides. The use of such friction factors in the Martinelli equation for turbulent heat transfer gives satisfactory estimates of the heat transfer for spoiler configurations.

Radiant Heat-Transfer Analysis of a Furnace or Other Combustion Enclosure. J. T. Bevans. *J. Heat Transfer 83,* 226 (1961) May (7 pp.)

Recently, the radiation exchange within an enclosure has been examined in general terms. Method presented in article is an application of certain features of this study and is an extension of it. The analysis is similar in many ways to the network analogy, but can be solved with less complex procedures. Certain aspects of the method are analogous to those used in the method of Lobo and Evans. In contrast with the latter analysis, a more detailed examination of the heat flux and temperature variation over the surfaces of the enclosure may be made. Thus the proposed method permits a more complete analysis of the radiation heat transfer, using some of the physical simplicity of the method of Lobo and Evans, but with less difficulty than the methods of either Hottel or Oppenheim.

Radiation Heat Transfer in a Spherical Enclosure Containing a Participating, Heat-Generating Gas. E. M. Sparrow, C. M. Usiskin and H. A. Hubbard. *J. Heat Transfer 83,* 199 (1961) May (8 pp.)

Analysis is made of the thermal radiation in an absorbing-emitting nonisothermal gas confined in a hollow spherical enclosure or in the space between two concentric spheres. This gas is gray and contains a volume heat source, while the bounding walls are black and isothermal. The conservation of energy principle yields an integral equation which has been solved for a wide range of geometric and radiative conditions. It is found that as the absorption coefficient increases in a fixed geometry, the gas temperature decreases and becomes more nonuniform. On the other hand, as the enclosure size increases, the gas temperature increases and becomes more nonuniform. An approximate analysis using a conduction-type transfer law has been carried out, and the results are compared with the integral equation solutions.

The Effect of Density Variation on Heat Transfer in the Critical Region. Y. Y. Hsu and J. M. Smith. *J. Heat Transfer 83,* 176 (1961) May (7 pp.)

The heat transfer coefficient between fluid and tube wall in turbulent flow depends upon the physical and thermal properties of the fluid. When density changes across the diameter of the tube are large (for example, when the fluid is near the critical point), the variable density can affect the transfer of momentum and heat. Equations are developed for predicting the magnitude of this effect on the heat transfer coefficient. Deissler's expressions for the eddy diffusivity are employed in solving the equations for heat and momentum transfer. The derived equations are applied for carbon dioxide flow in the critical region under the conditions for which experimental data were measured by Bringer and Smith. Because of the high Reynolds and low Grashof numbers, natural convection is not significant. However, the effect of the large density variations is found to be significant, and the predicted results agree well with the experimental data.

Hydrogen Sulfide

The First Ionization Constant of Hydrogen Sulfide in Water. H. L. Loy and D. M. Himmelblau. *J. Phys. Chem. 65,* 264 (1961) Feb. (4 pp.)

Recent developments in radioactive tracing techniques and the availability of radioactive tracers have been exploited together with standard conductance techniques to determine the thermodynamic first ionization constant of hydrogen sulfide:

$$K_1 = [(m_{H^+})\ (m_{HS^-})/(m_{H_2S})]\ [(\gamma_{H^+})\ (\gamma_{HS^-})/(\gamma_{H_2S})].$$

The apparent ionization constant of H_2S was determined at successively lower concentrations of H_2S in the range of 1×10^{-3} to 16×10^{-3} molal, and a true thermodynamic constant evaluated by extrapolation to infinite dilution. Water with a conductivity of 0.25×10^{-6} mho at 25°C was used. The values obtained for the first ionization constant were $0.271 \times 10^{-7} \pm 4\%$, $0.87 \times 10^{-7} \pm 4\%$ and $1.52 \times 10^{-7} \pm 7\%$ at 0, 25 and 50°C, respectively.

Kinetics

A Possible Error in the Measurement of Rate Constants of Gaseous Reactions by Flow Techniques. J. J. Batten. *Australian J. Appl. Sci. 12,* 11 (1961) Mar. (14 pp.)

In the interpretation of kinetic measurement of chemical reactions performed in flow systems in which a tubular reactor equipped with narrow inlet and outlet tubes

has been employed, it has usually been tacitly assumed that plug flow has existed throughout the whole volume of the reactor, under all experimental conditions. To test the validity of this assumption, experiments were designed to determine the nature of the flow pattern developed within such reactors. These experiments have shown, contrary to the preceding assumption, that under a wide range of experimental conditions, the bulk of the gas flows through the reactor without diffusing laterally to any appreciable extent. This observations throws considerable doubt on the interpretation of all published kinetic measurements obtained under similar experimental conditions, where the results have been calculated assuming that plug flow has existed throughout the length of the reactor.

High-Temperature Kinetics in Turbulent Combustors. W. D. Weatherford, Jr., J. P. Cuellar, Jr. and R. K. Johnston. *Ind. Eng. Chem. 53,* 398 (1961) May (3 pp.)

Experimental studies of high-temperature hydrocarbon fuels were conducted with a small turbulent-vortex combustor to investigate carbon-deposition tendencies detrimental to the performance and durability of aircraft gas turbine engines. Kinetic analysis of deposition data, supported by combustor metal-loss data from another laboratory, suggests that both deposition and metal loss involve chemisorption of fuel-derived intermediates on active metal sites.

Nitrogen

Reaction of Nitrogen Atoms with Ozone. M. C. Chen and H. A. Taylor. *J. Chem. Phys. 34,* 1344 (1961) Apr. (4 pp.)

Reaction of ozonized oxygen and active nitrogen at room temperature has been shown to produce, almost exclusively, nitrous oxide. Rate measurements in a flow system have been analyzed as involving a primary reaction $N+O_3 \rightarrow NO+O_2$. Accepting present values for the specific rates of subsequent reactions of nitric oxide, the rate of the primary reaction is found to be 10^{10} ml/mole sec. This is several orders faster than the reaction of nitrogen atoms and oxygen molecules, and many orders faster than the three-body recombination of atomic nitrogen and atomic oxygen.

Phase Equilibria

***n*-Butane—1-Butene—Water System in the Three-Phase Region.** A. H. Wehe and J. J. McKetta. *J. Chem. and Eng. Data 6,* 167 (1961) Apr. (6 pp.)

Available data on systems involving water and mixtures of pure hydrocarbons at elevated temperatures and pressures are scarce. This research on the *n*-butane—1-butene—water system was undertaken to add to the existing knowledge of phase equilibria in systems involving mixtures of pure hydrocarbons and water at elevated temperatures and pressures.

Partial Volumetric Behavior in Hydrocarbon Systems. Ethane and *n*-Pentane in the Liquid Phase of the Ethane—*n*-Pentane System. H. H. Reamer, V. Berry and B. H. Sage. *J. Chem. and Eng. Data 6,* 184 (1961) Apr. (8 pp.)

Recently, the volumetric and phase behavior of the ethane—*n*-pentane system was investigated (see *Gas Abstracts 16,* 47). In addition, the phase behavior of the methane-ethane—*n*-pentane system has been studied over a limited range of temperatures. On the basis of the foregoing data, with primary reference to the recent study of the volumetric behavior of the ethane—*n*-pentane system, the values of the partial volumes of ethane and *n*-pentane were evaluated.

P-V-T Relations

Extreme Pressures. II. Volume-Temperature Relationship for Gases. L. S. Levitt. *J. Chem. Phys. 34,* 1440 (1961) Apr. (4 pp.)

In a previous investigation, it was shown that experimental pressure-volume data at constant temperature and extreme pressures (from 10^3 to 10^5 atm) are represented accurately by the equation $p = C \exp(B/V)$, or $\ln(p_2/p_1) = B(1/V_2 - 1/V_1)$, where B and C are constants characteristic of a particular gas, liquid or solid. This relation holds well for gases above 1000 atm, for liquids above 4000 atm, and for solids above 25,000 atm. In the current study, it is shown that the temperature-volume relation at constant pressure for substances under extreme pressures is likewise a suprisingly simple one.

Sulfur Dioxide

Application of Benedict-Webb-Rubin Equation of State to Sulfur Dioxide. T. L. Kang and J. J. McKetta. *J. Chem. and Eng. Data 6,* 227 (1961) Apr. (2 pp.)

Purpose of work reported was to determine the specific coefficients for the BWR equation from the experimental pressure-volume-temperature data of gaseous sulfur dioxide and to study whether this equation would represent satisfactorily the volumetric behavior of sulfur dioxide in the gas phase.

Pressure-Volume-Temperature Properties of Sulfur Dioxide. T. L. Kang, L. J. Hirth, K. A. Kobe and J. J. McKetta. *J. Chem and Eng. Data 6,* 220 (1961) Apr. (7 pp.)

Pressure-volume-temperature properties of sulfur dioxide were determined using a Burnett apparatus and a Beattie-type apparatus. The temperature range was 10°-250°C, and the pressure range was 1-312 atm. Critical constants of sulfur dioxide also were determined. Vapor pressures and orthobaric densities were measured and correlated. Latent heats of vaporization were evaluated from the Clapeyron equation. Smoothed compressibility factors and fugacity coefficients for gaseous sulfur dioxide were calculated for pressures up to 315 atm over the temperature range from 10°-250°C. Second virial coefficients were evaluated by Hirth from the low-pressure PVT data.

Thermal Conductivity

Alignment Charts for Transport Properties. Viscosity, Thermal Conductivity, and Diffusion Coefficients for Nonpolar Gases and Gas Mixtures at Low Density. R. S. Brokaw. *NASA* Tech. Rep. R-81. (Washington, D. C.: U. S. Govt. Print. Off., 1961; 23 pp. $.35).

Alignment charts designed to permit rapid calculations of the low-pressure transport properties of nonpolar gases and gas mixtures are presented. Calculations for pure gases are based on the rigorous kinetic theory of gases as applied to a realistic intermolecular force law. Mixture viscosities and conductivities are calculated from good approximations derived from rigorous theory. The properties are calculable with a precision of 2 percent or better. Force constants are tabulated for 65 gases.

Thermal Conductivity and Prandtl Number of Carbon Dioxide and Carbon-Dioxide Air Mixtures at One Atmosphere. J. L. Novotny and T. F. Irvine, Jr. *J. Heat Transfer 83,* 125 (1961) May (8 pp.)

By measuring laminar recovery factors in a high-velocity gas stream, experimental determinations were obtained of the Prandtl number of carbon dioxide over a temperature range from 285° to 450°K and of carbon-dioxide air mixtures at an average temperature of 285°K with a predicted maximum error of 1.5 percent. Thermal conductivity values were deduced from these Prandtl numbers and compared with literature values measured by other methods. Using intermolecular force constants determined from literature experimental data, viscosities, thermal conductivities, and Prandtl numbers were calculated for carbon-dioxide air mixtures over the temperature range 200°-1500°K for mixture ratios from pure air to pure carbon dioxide.

Thermodynamics

Mixing Gases and Gibbs' Paradox. P. Chambadal. *Eng. 190,* 398 (1960) Sept. (2 pp.) [From *Appl. Mech. Rev. 14,* 234 (1961) Mar.]

Gibbs' paradox presents a discontinuity in the usual theory of gas mixtures which cannot easily be justified. A new solution is presented.

From author's summary

Transport Phenomena. R. B. Bird, W. E. Stewart and E. N. Lightfoot. (New York: John Wiley & Sons, Inc. 1960, xii + 780 pp. $13.75). [From *Appl. Mech. Rev. 14,* 234 (1961) Mar.]

Book provides a new unified approach to the theory and analysis of processes in which momentum, heat, or matter is transported by conduction or diffusion, or by turbulence. In effect, intermediate-level texts on fluid dynamics, heat transfer, and diffusion have been coordinated and combined. Many tables list equivalent or analogous forms of similar equations, for comparison purposes, and worked examples are frequent.

C. F. Bonilla, USA

An Experimental Investigation into Heat Conductance of Argon. N. V. Tzederberg, V. N. Popov and N. A. Morozova. *Teploenergetika* No. 6 82 (1960) June (7 pp. Russian text.) [From *Appl. Mech. Rev. 14,* 317 (1961) Apr.]

Experimental investigation into heat conductance of argon was carried out by isobars 1, 100, 200, 300, 400 and 500 kg/cm² in the interval of temperatures from —70° to +400°C. The equation describing heat conductance of the argon under pressure and the table of heat conductance values up to 600°C are given.

From authors' summary

Heat Recovery in the Wet Steam Region. H. Bohn. *Brennstoff-Warme-Kraft 12,* 314 (1960) July (4 pp. German text.) [From *Appl. Mech. Rev. 14,* 390 (1961) May]

As the saturated steam turbines of nuclear reactors use saturated steam up to 600 psi, the article investigates how far the data for determining the heat recovery, which are applicable for the normal low-pressure stages of condensing turbines with much lower pressures, are also valid for high pressures. It is shown that the heat recovery for a wider pressure range depends on the initial pressure. A nomogram for the extended pressure range is developed for the heat recovery in the wet steam region.

From authors' summary

Vaporization

The Vapor Pressure Heat of Vaporization and Heat Capacity of Methane from the Boiling Point to the Critical Temperature. P. Hestermans and D. White. *J. Phys. Chem. 65,* 362 (1961) Feb. (4 pp.)

The vapor pressures, heats of vaporization and heat capacities of methane from the boiling point to the critical temperature have been measured. The vapor pressure data have been represented in the form log $P_{atm} = 3.984667 - 444.6667/T - \sigma(T)$, where $\sigma(T)$ is tabulated at equal intervals of temperature. The normal boiling point of methane is 111.42°K. Critical constants have been calculated from the vapor pressure data. It is shown that the measured heats of vaporization are in good agreement with those calculated from the preceding vapor pressure equation and the known liquid and gaseous densities. The heat capacity data, when combined with the measured heats of vaporization, yield entropies for the gas along the saturation curve in excellent agreement with those from statistical calculations.

Viscosity

Molecular Transport Properties of Fluids. E. F. Johnson. *Ind. Eng. Chem. 53,* 409 (1961) May (4 pp.)

Review is concerned with the important publications on the viscosity and thermal conductivity of Newtonian fluids which have appeared from October 1959 through most of 1960. During this period, the volume of significant publications was substantially greater than in previous years. There were no startling breakthroughs or advances, but a number of fine reviews consolidated much of the knowledge, and extension of the experimental and theoretical work to more systems and broader ranges of conditions continued.

The Viscosity of Steam and Water at Moderate Pressures and Temperatures. J. R. Moszynski. *J. Heat Transfer 83,* 111 (1961) May (14 pp.)

Paper reports the results of an investigation of the viscosity of steam and compressed water. The measurements were carried out by means of an oscillating-body-type viscometer in order to develop an alternative method of measurement to the usually employed capillary viscometer, and also to provide an independent check on published data. The results for compressed water, obtained with the aid of an oscillating sphere, represent absolute measurements, and cover a range from 3 to 340 atm and from 20° to 186°C. The viscosity of water is shown to have a negative pressure coefficient below 35°C and a positive coefficient above that temperature. The maximum change in viscosity, at any given temperature over the pressure range covered, is 5 percent. The results show good agreement with previously published data.

Viscosity of Dissociated Gases from Shock-Tube Heat-Transfer Measurements. R. A. Hartunian and P. V. Marrone. *J. Phys. Fluids 4,* 535 (1961) May (9 pp.)

Measurements of the heat transfer from dissociated oxygen to the sidewall of a shock tube have been made over a wide range of operating conditions using the methods of thin-film thermometry. Numerical solutions of the equilibrium shock tube wall boundary layer equations for several values of the Lewis number have been obtained. The results show the heat transfer to be very weakly dependent upon the Lewis number. This fact indicates the shock tube wall boundary layer to be a source for experimental determinations of the viscosity coefficient of dissociated gases.

The Couette Flow When Taking into Account the Relation of Viscosity to Temperature and Heat Generated by Friction. V. S. Yablonskii and S. A. Kaganov. *Izv. Vyssh. Uchebn. Zavedenii Neft'i Gas, 57* (1958) No. 5 (9 pp. Russian text); *Ref. Zh. Mekh.* No. 9 (1959) Rev. 10176. [From *Appl. Mech. Rev. 14,* 381 (1961) May]

On the assumption that the local coefficient of viscosity depends on the temperature, authors find a solution for a system of differential equations for the flow of a viscous liquid between two parallel plates one of which is moving in relation to the other with a certain constant velocity. Four arbitrary constants entering the solution are determined from the boundary kinematic and thermal conditions. An analysis of the solution follows with different boundary conditions being taken into consideration. Special solutions found previously by other authors are discussed.

V. S. Sokolov
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